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This study was designed to provide information on the cumulative Environmental Impacts resulting from the implementation of Subtitle C of the Resource Conservation and Recovery Act. Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA) requires the Office of Solid Waste (OSW) to develop criteria that will identify hazardous wastes and promulgate standards that will regulate generators, transporters, handlers, and disposers of hazardous wastes. The preparation of this EIS was to assist EPA in (a) comparing trade-offs among alternative courses of action, (b) promoting public understanding of Agency decisions, (c) facilitating public participation in the decision making process, (d) and ~~identify~~ identifying areas where additional information and data was needed.

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FINAL
ENVIRONMENTAL IMPACT STATEMENT
PART I

FOR

SUBTITLE C, RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 (RCRA)

APPENDICES

PREPARED BY
OFFICE OF SOLID WASTE
U.S. ENVIRONMENTAL PROTECTION AGENCY
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APPENDIX A

SELECTED STATE HAZARDOUS WASTE REGULATIONS

This appendix contains brief descriptions of selected state hazardous waste regulations as of 1978. These descriptions are presented solely to enable a better understanding of the intent of the state regulations summarized in Chapter 2. The descriptions are not meant to provide an exhaustive delineation of the hazardous waste regulations that existed in each of the selected states. This appendix also presents selected examples of mechanisms used by some states to control hazardous wastes in the absence of specific hazardous waste legislation.

A.1 Regulations Applicable to Generators

The following is a summary of promulgated and proposed state hazardous waste regulations that apply to generators of hazardous waste.

A.1.1 California. Based on the revised regulations for hazardous waste (State of California, 1977a):

- Permit System. The producer of an extremely hazardous waste, as defined in the regulations, shall apply for a permit before these wastes can be disposed. The application for this permit should include information on the amount and type of waste, the proposed method for handling and disposal, and the name and address of the proposed hauler and disposer. This permit is required in addition to the manifest.

- Manifest System. The producer of any hazardous or extremely hazardous waste to be disposed off-site by other than a pipeline shall complete and sign the Producer of Waste section of the manifest, documenting the quantity and characteristics of the waste. The producer of the waste shall include transportation data on the manifest as required by the California Highway Patrol. In cases where a different waste hauler is utilized, a new manifest is required. Each manifest shall indicate the volume of waste to be transported by the hauler. Each month the producer shall submit a copy of each manifest containing all the information required in the Producer and Hauler sections of the manifest.

- Recordkeeping. Where a producer is also an on-site disposer of hazardous materials, a record of all waste disposal during the previous month, giving a qualitative and quantitative summary, and the plan of disposal shall be kept and submitted to the Department each month.

- Reporting. Operators of on-site disposal facilities are to submit monthly reports to the Department on the information compiled in records and on the amounts of fees due payable to the Department.

- Inspection. The Director may inspect any facility where hazardous wastes are kept, obtain samples, or inspect records relating to the management of hazardous wastes.

- Enforcement. The requirements of compliance are to be enforced by the Director or any authorized representative.

A.1.2 Georgia. Based on Guidelines for the Management of Hazardous Solid Wastes (State of Georgia, 1977):

- Permit System. Generators of hazardous wastes must submit a request for approval of management procedures planned for the handling and disposal of hazardous wastes.

- Recordkeeping. Records of the amounts, characteristics, and dates hazardous wastes are sent to approved hazardous waste disposal sites must be made available for examination by the Environmental Protection Division.

- Enforcement. Enforcement is promulgated under the authority of Act 1486, Solid Waste Management Act, Georgia Laws of 1972, as amended.

A.1.3 Illinois.

- Permit System. All generators of hazardous wastes have been identified and their wastes characterized as part of the solid waste management program. A generator of hazardous wastes must file an application giving the quantity and characteristics of the waste going for disposal. A permit is also required for on-site disposal.

- Manifest System. The applicant's permit must match up with that of the disposer's permit.

- Enforcement. Although there are no formalized regulations at this time, the enforcement of the system is carried out through the authority of the Illinois Environmental Protection Agency, Division of Land Pollution Control.

A.1.4 Maryland. Based on Title 08 Department of National Resources, Subtitle 05 Water Resources Administration, Section 08.05.05 Control of the Disposal of Designated Hazardous Substances:

- Permit System. Generators are required to notify the Administration as required, giving the names and volumes of wastes and a plan of disposal.

- Manifest System. For a Class I or Class II hazardous waste, the generator shall provide two copies of the manifest to a certified hauler and one copy to the Administration specifying the origin and destination of the waste, the volume and character of the waste, and potential dangers to the public and the environment.

- Reporting. Reporting shall be consistent with the requirements developed by other State agencies.

- Monitoring. Monitoring shall be consistent with the requirements developed by other State agencies.

- Enforcement. Violators shall be subject to the civil and criminal liabilities as specified in the Natural Resources Article, Annotated Code of Maryland.

A.1.5 Minnesota. Based on the proposed rules from the Pollution Control Agency for the disposal of hazardous waste:

- Permit System. Part of the required disclosure shall include the NPDES or State Disposal Permit number where applicable.

- Manifest System. The generator of the waste shall be required to prepare hazardous waste shipping papers. These shipping papers are to include information on the generator, the identifying shipping number, the amount and full characteristics of the waste, procedures for safety and accident occurrences, other wastes to be combined, the transporters' agency identification number, and any other information the generator deems important. Upon transfer of the waste, the transporter or facility operator accepting the waste shall sign each copy of the shipping papers. The generator of a shipment of hazardous waste shall maintain the original copy of the shipping papers for five years. At the request of the Director of the Agency, the generator shall submit a copy of the shipping papers to the Agency.

- Recordkeeping. The generator of a shipment of hazardous waste shall retain a copy of the shipping papers for five years.

- Reporting. Each generator is required to submit a disclosure to the Agency for quantities being transported within the state or outside the state. For existing wastes, the generator shall submit this disclosure within one year, and for new wastes, the generator shall submit the disclosure within 90 days after first producing the waste. Accidents and/or spills are to be reported.

- Inspection. An authorized party of the Agency may enter the property where a waste is produced and collect samples of the waste for further examination.

- Enforcement. The Minnesota Pollution Control Agency is designated as the agency responsible for enforcement of the proposed regulations.

A.1.6 Missouri. Based on Missouri Hazardous Waste Management Law HB 318:

- Manifest System. In order that the waste may be tracked, a shipping document or manifest must be initiated by the waste generator. A copy shall be retained by the generator and by the Department of Natural Resources.

- Reporting. Generators must register their hazardous wastes with the Department in order to comply with the manifest requirements.

- Enforcement. Enforcement of this law is the responsibility of the Department of Natural Resources. Intentional falsification of information or records is subject to fine and/or imprisonment.

A.1.7 Montana. Based on the 1977 Montana State Plan for Solid Waste and Hazardous Waste Management and Resource Recovery (State of Montana, 1977) and the Montana Solid Waste Management Act:

- Permit System. Where the generator of hazardous waste is disposing on-site, a permit or license is required by the state based on approval of site characteristics, engineering designs, and operational plans.

- Manifest System. The generator of a shipment of hazardous waste shall fill out the assigned portion of the manifest which will accompany the waste to the disposal site.

- Recordkeeping and Reporting. Generators shall be required to keep records and submit reports concerning the quantities, types, and deposition of hazardous wastes.

- Inspection. Where wastes are disposed or stored on-site, the State has the authority to inspect the facility for compliance with the Montana Solid Waste Management Act.

- Enforcement. Enforcement of the plan for hazardous waste management is carried out through the authority of the Montana Department of Health and Environmental Sciences.

A.1.8 Oklahoma. Based on the contents of Rules and Regulations for Industrial Waste Management (State of Oklahoma, 1977):

- Manifest System. Although not called a "manifest" per se, all generators of industrial waste shall file a plan with the Department to include the quantity and characterization of the waste; the percentage of liquids; the type, volume, and duration of storage facilities; the disposal method proposed, including any pretreatment; the disposal sites used; and the waste haulers used. In addition, the generator shall provide three copies of a shipping report to the hauler for each load of waste material shipped. This shipping report will contain the assigned disposal plan number, the type, amount, approximate content, origin, and destination of the waste.

- Reporting. The generator shall submit annual reports to the Department.

- Enforcement. Legal enforcement is based on the authority granted under The Oklahoma Industrial Waste Disposal Act, Title 63.

A.1.9 Oregon. Based on Oregon Hazardous Waste Management Regulations (State of Orgeon, 1976):

- Manifest System. The State is presently in the process of designing a workable manifest system. Generators shall be required to use a department-approved manifest to assure that all hazardous wastes generated are destined for treatment, storage, or disposal at approved facilities.
- Recordkeeping. The generator shall keep records that accurately identify the quantities, constituents, and disposition of the hazardous wastes.
- Reporting. The generator shall submit reports to the department determining the quantities of hazardous waste generated during a given period of time and the disposition of all such wastes.
- Enforcement. Both the existing and proposed regulations are to be enforced under the authority of the Department of Environmental Quality.

A.1.10 Texas. Based on Texas Regulation of Industrial Solid Waste Management (State of Texas, 1975) and Municipal Solid Waste Management Regulations (State of Texas, 1977a):

- Manifest System. All off-site shipments of industrial wastes must be accompanied by a Texas Water Quality Board Industrial Waste Shipping Control Ticket. One copy of this ticket will be retained for the generator's records.
- Recordkeeping. Generators of Class I waste shall compile a monthly Off-Site Disposal Summary from their copies of shipping tickets. Generators who dispose of Class I or Class II industrial waste on-site must maintain records of their on-site disposal activity. These records shall include, as a minimum, information regarding the quantity, character, and classification of the waste and the method and location of disposal. All copies of shipping tickets and records of Class II off-site disposal and records of Class I and Class II on-site disposal shall be retained for at least three years.
- Reporting. Generators of Class I waste shall submit a monthly Off-Site Disposal Summary to the Texas Water Quality

Board itemizing the quantity and classification of waste by shipping ticket number. This summary shall be submitted monthly regardless of the number of shipments made during the month. On-site generators who dispose of Class I or Class II waste may be required to compile an Annual Disposal Summary from their records to be submitted to the Texas Water Quality Board.

- Enforcement. Legal enforcement is based on the authority of the Texas State Department of Health, and the Texas Water Quality Board.

A.1.11 Washington. Based on the proposed draft regulations:

- Manifest System. It is the responsibility of the generator of the waste to fill out the manifest, as supplied with the generator's name and address, the origin, quantity, quality, maximum and minimum percentages of the components, measures to be taken in case of an accident, and other data as requested by the Department. The requirements for the manifest include notifying the disposal site operator, preparing the hazardous waste for shipment by compliance with the Utilities and Transportation Commission, and the Department of Transportation. The original of each manifest is given to the transporter, and written notification of each transfer is sent to the Department. Manifest information is contained under Section WAC 173-302-80 and WASC 173-302-190. Treaters are considered as generators when the treatment process only partly treats an environmentally hazardous waste.

- Enforcement. Enforcement of hazardous waste regulations is enumerated under Hazardous Waste Disposal, Section RCW 70.105.080. The authority of enforcement is carried out by the Department and is enforceable under penalty.

A.2 Regulations Applicable to Transporters

The following is a summary of promulgated and proposed state hazardous waste regulations that apply to the transporters of hazardous waste.

A.2.1 California. Based on the revised regulations for hazardous waste (State of California, 1977a):

- Permit System (Registration). Although not operated as a permit system, all transporters of hazardous waste must apply for registration as a hazardous waste hauler. Persons registered by the State Water Resources Control Board as liquid haulers will be registered as hazardous waste haulers by reciprocity upon signing a statement certifying that the applicant understands and will comply with applicable requirements. The Director retains the authority to suspend or revoke registration as a hauler of hazardous wastes.

- Manifest System. The hauler may not accept hazardous wastes unless the manifest has been completed and signed by the generator of the waste. After completing the Hauler and Waste section of the manifest, the hauler shall have a copy of the completed manifest while transporting the hazardous waste and shall provide the operator of the disposal site with a copy. Haulers transporting hazardous waste into or out of the state shall retain a completed copy of the manifest while in transit. Haulers transporting hazardous wastes out of state shall forward to the Department a copy of the manifest completed by the producer, the hauler, and the disposer.

- Recordkeeping. Hazardous waste haulers shall maintain records for at least three years on the character and quantity of waste transported, to include pertinent information on the producer and disposer.

- Reporting. The hauler is to submit to the Department a copy of the manifest completed by the producer, hauler, and facility operator for each load of hazardous waste transported out-of-state within 30 days of the date that the load is transported. In addition, the hauler shall comply with reporting requirements, as indicated by the California Highway Patrol regarding the transportation of hazardous materials. Under Section 60263, haulers of hazardous wastes are obligated to report, within 24 hours, any accidents or incidents which could result in adverse effects, or the discharge of hazardous wastes outside of the designated disposal area. A written report of the incident may also be requested.

- Inspection. The Director of the Department is authorized to inspect any vehicle suspected of transporting hazardous wastes and to obtain samples of the waste in transport.

- Enforcement. The requirements of compliance are to be enforced by the Director or any authorized representative.

A.2.2 Maryland. Based on Title 08 Department of Natural Resources, Subtitle 05 Water Resources Administration, Section 08.05.05 Control of the Disposal of Designated Hazardous Substances:

- Permit System (Certification). The transporter shall submit a request for certification providing information on the nature and quantity of hazardous waste transported, the source and destination of the waste, the method of transport, and specific information on the transport vehicle. Certification shall be carried in the vehicle at all times.

- Manifest System. The transporter must provide a copy of the manifest to the facility operator.

- Reporting. The transporter must report periodically on the source, destination, volume, and nature of hazardous waste transported.

- Enforcement. Violation shall be subject to the civil and criminal liabilities as specified in the Natural Resources Article, Annotated Code of Maryland.

A.2.3 Minnesota. Based on the Proposed Rules from the Pollution Control Agency for the Disposal of Hazardous Waste:

- Permit System. All transporters are required to register with the Agency and obtain an identification number prior to transporting hazardous wastes.

- Manifest System. The transporter shall not accept any shipment of hazardous waste unless it is accompanied by generator copies of the hazardous waste shipping papers. The transporter shall sign the shipping papers, retain one copy, and shall return one copy to the generator after relinquishing possession of the waste.

- Recordkeeping. The transporter shall maintain a copy of the shipping papers for five years.

- Reporting. Accidents and/or spills are to be reported to the Agency.

- Enforcement. The Minnesota Pollution Control Agency is designated as the agency responsible for enforcement of the proposed regulations.

A.2.4 Missouri. Based on Missouri Hazardous Waste Management Law HB 318:

- Permit System (License). Transporters must obtain a license from the Department of Natural Resources demonstrating that their equipment and operations meet Federal hazardous materials safety standards. Demonstration of financial responsibility and annual fees up to $100 per year may be required.
- Manifest System. The manifest shall accompany the waste in transport, and a copy will be retained by the transporter. Transporters may accept only shipments of hazardous waste accompanied by a manifest.
- Enforcement. Enforcement of the law is the responsibility of the Department of Natural Resources. The Highway Patrol and other law enforcement agencies are empowered to arrest and retain transporters violating any transportation provisions of the law.

A.2.5 Montana. Based on the 1977 Montana State Plan For Solid Waste and Hazardous Waste Management and Resource Recovery (State of Montana, 1977) and the Montana Solid Waste Management Act:

- Permit System (License). Each person or business involved in the transport of hazardous materials must be licensed by the State Department of Health and Environmental Sciences.
- Manifest System. The transporter of hazardous wastes shall complete the appropriate sections of the manifest form.
- Recordkeeping. All transporters of hazardous waste shall maintain records concerning the wastes transported.
- Enforcement. Enforcement of the plan for hazardous waste management is carried out through the authority of the Montana Department of Health and Environmental Sciences.

A.2.6 Oklahoma. Based on the contents of Rules and Regulations for Industrial Waste Management (State of Oklahoma, 1977):

- Permit Systems. Transporters of industrial wastes must be licensed by the Department.

- Manifest System. The generator of the waste shall provide a copy of the manifest. The drivers shall have the manifest in their possession while carrying the waste and shall surrender the manifest to the disposer at the time of delivery.

- Reporting. The transport of industrial wastes into Oklahoma shall be in accordance with reciprocity agreements, approved by the Director of the Controlled Industrial Waste Management Section and by the Governor.

- Enforcement. Legal enforcement is based on the authority granted under the Oklahoma Industrial Waste Disposal Act, Title 63.

A.2.7 Oregon. Based on Oregon Hazardous Waste Management Regulations (State of Oregon, 1976):

- Permit System. Transportation of hazardous wastes shall be in compliance with the rules of the Public Utility Commissioner of Oregon and other local, State, or Federal agencies.

- Manifest System. Transporters shall be required to deliver hazardous wastes to a site named in the manifest.

- Enforcement. Both the existing and proposed regulations are enforceable under the authority of the Department of Environmental Quality.

A.2.8 Texas. Based on Texas Regulation on Industrial Solid Waste Management (State of Texas, 1975) and Municipal Solid Waste Management Regulations (State of Texas, 1977a):

- Manifest System. The carrier receiving industrial wastes for shipment will complete Part II of the shipping ticket and deliver the waste materials and shipping ticket to the designated destination. Upon delivery, the carrier shall obtain the signature of the receiving waste manager or other authorized representative. The carrier shall return the original to the shipper and retain the final copy for his records.

- Recordkeeping. Shippers shall keep records of Class I waste and shall compile a monthly Off-Site Disposal Summary from their copies of shipping tickets. For on-site disposal, shippers shall keep records of Class II waste shipped without shipping tickets. These records must include, as a minimum, the carrier identity, date of shipment, and the waste description and quantity.

- Reporting. Carriers and shippers shall compile a monthly Off-Site Disposal Summary from their copies of shipping tickets to be submitted to the Texas Water Quality Board. The quantity and classification of waste shall be itemized by shipping ticket number.

- Enforcement. Legal enforcement is based on the authority of the Texas State Department of Health, and the Texas Water Quality Board.

A.2.9 Washington. Based on Hazardous Waste Regulations WAC 173-302:

- Manifest System. It is the responsibility of the transporter to follow all existing requirements of the Utilities and Transportation Commission and the Department of Transportation. In addition, the transporter must transport the manifest with the waste and must deliver the manifest along with the waste to the treater or disposer. The transporter shall accept a separate manifest for each chemically separate and distinct waste being shipped.

- Reporting. Following an accident or spill, the transporter shall follow procedures as indicated on the back of the manifest.

- Inspection. The transporter shall inspect the vehicle after unloading to insure it has been rinsed and cleaned and that all of the delivered material has been transferred.

- Enforcement. Hazardous materials delivered out-of-state, or within the state are subject to the authority of the department.

A.3 Regulations Applicable to Off-Site Storers, Treaters, and Disposers

The following is a summary of promulgated and proposed state hazardous waste regulations that apply to off-site storers, treaters, and disposers of hazardous waste.

A.3.1 California. Based on the revised regulations for hazardous waste (State of California, 1977a):

- Permit System. A permit is required to establish, operate, or maintain a hazardous waste facility. In obtaining such a permit, an application must be filed with the Department; a report describing potential impacts to the environment may be required. An operation plan is also required which shall include the general characteristics and amounts of hazardous waste handled or received; a list of equipment kept on-site; a general description of operational procedures; a description of procedures for closure of the site; a map of the facility with specifications; and a contingency plan for emergencies or accidents. Before a permit can be issued, the regional water quality control board must issue discharge requirements. Among the conditions to be met is a review of the permit at least every five years. The operator of a disposal facility shall comply with permit modifications as issued by the Department. The Department has the authority to modify, suspend, or revoke a permit. Wastes considered as extremely hazardous will be regulated by permit in a similar, but distinctly separate manner in order to distinguish them from other hazardous wastes. A permit for recurring disposal of extremely hazardous wastes, valid for up to 12 months, will be available for extremely hazardous waste that is routinely produced.

- Manifest System. The operator of an off-site hazardous waste facility will inspect the delivered wastes before accepting them to assure that they are essentially the same as indicated by the producer on the manifest. After completing the Disposer of Waste section, copies of the manifest are forwarded to the Department on a monthly basis.

- Recordkeeping. Hazardous waste facility operators shall maintain records for at least three years on the character and quantity of waste received, hauled, or stored at the site; information on the producer, hauler, and processor; and a grid showing the location of disposal at the site.

- Reporting. Article 6, Section 60259, provides for the generation of monthly reports by the operator of off-site hazardous waste facilities. These reports are to include the amount of fees due and payable to the Department; information on the individual amounts of hazardous waste delivered through separate copies of the completed manifest; and a report collectively summarizing the quantities of hazardous waste disposed of for the previous month. Records of hazardous waste delivered by pipeline or disposed on-site should contain the same information as requested in the generator's copy of the manifest and are to be submitted to the Department on a monthly basis. Operators of hazardous waste facilities shall report within 24 hours any incident affecting public health and safety, wildlife, or incidents that could adversely affect any area other than that of the designated disposal site. A written report may be required by the Department.

- Inspection. The Director is authorized to inspect a factory, plant, construction site, waste disposal site, or transfer station and to obtain samples or conduct tests. The inspector is authorized to prepare a report listing any deficiencies found during the inspection, with a copy to be provided to the operator of the facility. If corrections are needed, the operator will provide a written plan of correction, stating actions to be taken and the dates of completion. Under the request of the inspector, the operator of the facility being inspected shall retain evidence as instructed by the inspector.

- Enforcement. The requirements of compliance are to be enforced by the Director or any authorized representative.

A.3.2 Georgia. Based on Guidelines for the Management of Hazardous Solid Waste, (State of Georgia, 1977):

- Permit System. As required in the solid waste regulations, a geologic and engineering report must be approved by the state for the operation of any disposal site. A permit is also required to store hazardous wastes or to send them out-of-state.

- Recordkeeping. A record or log of disposal activities is required of the site operators to include the characteristics and amounts of the hazardous waste, the date of disposal, the location of burial in the site, and other data as determined by the Environmental Protection Division.

- Monitoring. At least one groundwater monitoring well will be required at a site. The Division requires initial water samples prior to the start of operation, quarterly samples from nearby water supply wells, and periodic samples from nearby surface waters.

- Enforcement. Enforcement is promulgated under the authority of Act 1486, Solid Waste Management Act, Georgia Laws of 1972, as amended.

A.3.3 Illinois. Based on various permit applications and forms related to the management and disposal of "special wastes", as regulated by the Division of Land Pollution Control, Illinois Environmental Protection Agency:

- Permit Systems. Land disposal sites are subject to the Illinois Solid Waste Rules and Regulations which require a land disposal site operator to obtain an operating permit from the Agency. Prior to granting a permit, each site is reviewed relative to suitability and safety. For each special waste disposed at the site, an additional permit is needed. These supplemental permits are required for each separate special waste and include a detailed chemical analysis of the waste and information concerning the waste hauler, generator, and method of disposal.

- Manifest System. The disposer is required to file a permit application to allow the disposal of hazardous wastes at a permitted disposal site. This permit is to be matched up with the generator-permit copy.

- Recordkeeping, Reporting, Inspections, and Monitoring. At present only one site is authorized to accept the disposal of hazardous wastes. This site is fully monitored by the Illinois Environmental Protection Agency. Records are kept on monitoring data and on emergency incidents.

- Enforcement. Although there are no formalized regulations at this time, the enforcement of the system is carried out through the authority of the Illinois Environmental Protection Agency, Division of Land Pollution Control.

A.3.4 Maryland. Based on Title 08 Department of Natural Resources, Subtitle 05 Water Resources Administration, Section 08.05.05 Control of the Disposal of Designated Hazardous Substances:

- Permit System. A person proposing to construct, operate, or maintain a facility shall submit a preliminary report to the Administration showing geographical location, design objective, disposal and storage methods, and supporting site-specific data or studies to include geological conditions, surface and groundwater conditions, soil analyses, monitoring systems, treatment and pretreatment procedures, personnel employed, and equipment utilized. An application shall be submitted to the Administration to determine the adequacy of a facility based on the information in the preliminary report. A review period for comment by other state agencies shall be accorded as well as the opportunity for a public hearing. Upon review by the Administration, a permit may be issued for a term not to exceed 3 years and is to include requirements for monitoring, reporting, and bonding.

- Manifest System. The manifest shall be retained by the site operator and presented upon request to the Administrator.

- Monitoring and Reporting. The Administration shall require the installation of monitoring stations and may require periodic sampling and analysis. The collected data shall be submitted to the Administration upon request. Monitoring and reporting should be consistent as required by other State agencies. Monitoring and reporting requirements may be required as a condition of permit approval.

- Enforcement. Violation shall be subject to the civil and criminal liabilities as specified in the Natural Resources Article, Annotated Code of Maryland.

A.3.5 Minnesota. Based on the Proposed Rules from the Pollution Control Agency for the Disposal of Hazardous Wastes:

- Permit System. A permit is required to construct or operate a hazardous waste facility. The operator, storer, or treater of a facility shall submit a report presenting information on the subsurface conditions, existing land use, physical features, drainage patterns, groundwater quality, and any other information as required by the Agency.

- Manifest System. The operator shall obtain the completed shipping papers from the generator or transporter and shall sign these to verify acceptance of the waste. The papers shall be signed a second time upon actual disposition, and the original shall be returned to the generator.

- Recordkeeping and Reporting. The facility operator shall submit monitoring reports on a quarterly basis and shall file monthly summaries identifying the quantity of waste managed, the names of generators, and the identity of types of hazardous waste managed. A log shall be kept, to be submitted upon request, containing the dates of shipment arrival, shipment number, names of generators, names of transporters, location of site disposal, and the date of actual disposal or of transport from the facility.

- Monitoring. A site monitoring plan must be approved by the Agency before hazardous materials can be stored or accepted for disposal.

- Enforcement. The Minnesota Pollution Control Agency is designated as the agency responsible for enforcement of the proposed regulations.

A.3.6 Missouri. Based on Missouri Hazardous Waste Management Law HB 318:

- Permit System. Facility owners or operators must obtain a permit from the department and must operate their facility in accordance with the law, regulations, and any special conditions the department writes into the permit. Demonstration of financial responsibility is required and annual fees up to $1,000 per year per facility permit are provided. The department will hold a public hearing, on request, in the area of the facility's location, prior to issuing the permit.

- Manifest System. A copy of the manifest shall be retained by the facility operator. Facility operators or owners may accept only shipments of hazardous waste accompanied by a manifest.

- Recordkeeping, Reporting, Inspection, and Monitoring. Facility owners or operators must operate their facility in accordance with the law, regulations, and any special conditions that the department writes into the permit. Monthly reports are required.

- Enforcement. Enforcement of the law is given to the Department of Natural Resources. Intentional falsification of information or records is subject to fine and/or imprisonment.

A.3.7 Montana. Based on the 1977 Montana State Plan for Solid Waste and Hazardous Waste Management and Resource Recovery (State of Montana, 1977) and the Montana Solid Waste Management Act:

- Permit System. All hazardous waste management facilities are required to be licensed by the state, with the issuance of a license contingent upon approval of site characteristics, engineering designs, and operational plans. Special permits may also be granted for the disposal of small quantities of nonpersistent or low toxicity Group I wastes in approved disposal sites when no other disposal method is economically feasible.

- Manifest System. All storers, treaters, and disposers of hazardous wastes are to comply with the manifest system.

- Recordkeeping and Reporting. Storers, treaters, and disposers of hazardous materials shall be required to keep records and submit reports to include the identification of the location of each disposal area and the waste types disposed.

- Monitoring. To be in compliance with EPA requirements.

- Enforcement. Enforcement of the plan for hazardous waste management is carried out through the authority of the Montana Department of Health and Environmental Sciences.

A.3.8 Oklahoma. Based on the contents of Rules and Regulations for Industrial Waste Management (State of Oklahoma, 1977):

- Permit System. Permits are required for the construction and/or operation of industrial waste disposal sites. Construction permits require that a public hearing be held, that insurance liability be posted, that a performance board for monitoring and maintenance be posted, and that an engineering report accompany the application. An operational permit is issued based on an inspection by the Department. Issuance of the permit is contingent on monitoring, safety, and personnel compliance as required by the Department.

- Manifest System. The operator of each industrial disposal site shall include a certified copy of each shipping report in the monthly report to the Department.

- Recordkeeping. See Reporting.

- Reporting. Monthly operational reports shall be submitted to the Department listing the amount, transporter, and procedures of all controlled waste received. The operator shall also include a certified copy of each shipping report in the monthly report.

- Inspection. As specified in the Oklahoma Controlled Industrial Waste Disposal Act, the Department shall make periodic inspections of disposal facilities and sites.

- Monitoring. Air and water monitoring of the site may be required by the Department. In the case of injection well disposal, monitoring wells must be approved by the Department. Requirements are also included for the monitoring of closed facilities.

- Enforcement. Legal enforcement is based on the authority granted under the Oklahoma Industrial Waste Disposal Act, Title 63.

A.3.9 Oregon. Based on Oregon Hazardous Waste Management Regulations (State of Oregon, 1976):

- Permit System. The Department may authorize the disposal of specified hazardous wastes at specified solid waste disposal sites after a determination that such disposal will not pose a threat to public health and safety. A license from the department is required by any party planning to construct or operate a hazardous waste disposal facility. The applicant must demonstrate financial responsibility and a plan of management to include an engineering report and description of hydraulic conditions.

- Manifest System. Each hazardous waste collection site licensee shall be required to participate in the manifest system.

- Recordkeeping. Each hazardous waste collection site licensee shall be required to maintain records of any hazardous waste stored at the site and the manner of storage, transport, and disposal.

- Reporting. Each hazardous waste collection site licensee shall report periodically to the department on types and volumes of wastes received and their manner of deposition.

- Inspection. The department is authorized to investigate the operation of any hazardous waste disposal site that it believes to be unsafe.

- Monitoring. The department shall establish and operate a monitoring and surveillance program over all hazardous waste disposal and collection sites.

- Enforcement. Both the existing and proposed regulations are enforceable under the authority of the Department of Environmental Protection.

A.3.10 Texas. Based on Texas Regulation on Industrial Solid Waste Management (State of Texas, 1975), and Municipal Solid Waste Management Regulations (State of Texas, 1977a):

- Permit System. A permit from the Texas Water Quality Board is required for the construction, development, or operation of a commercial industrial solid waste disposal site. Permit issuance shall depend on the approval of engineering plans and specifications, operating procedures, and a staffing pattern including the qualifications of all key operating personnel. These plans should be sufficient to allow for compliance with all pertinent state and local air, water, and solid waste statutes and regulations. A public hearing shall be held on each permit application and a bonding requirement will be established upon issuance of a permit.

- Manifest System. The receiver of the waste shipment will complete Part III of the shipping ticket and retain one copy for his records, returning the original and one copy to the carrier.

- Recordkeeping. All copies of shipping tickets and records of off-site disposal shall be retained for a minimum of three years and shall be kept readily available for review upon request by the Texas Water Quality Board staff. For purposes of identifying the waste materials so that a waste classification code may be assigned, a chemical analysis and a written description may be required, and/or samples may be required for analysis.

- Reporting. Receivers of Class I waste shall compile a monthly Receipt Summary from their copies of shipping tickets to be submitted to the Texas Water Quality Board.

- Enforcement. Legal enforcement is based on the authority of the Texas State Department of Health, and the Texas Water Quality Board.

A.3.11 Washington. Based on Hazardous Waste Regulations WAC 173-302:

- Permit System. At present there is only one disposal facility in the state that is authorized to accept hazardous wastes. According to the existing legislation, the operating requirements for this site are set in a yearly operating plan. A contract between the State and the operator delineates the legal and financial requirements. Environmental, security, safety, emergency, and personnel requirements are reflected.

- Manifest System. Treaters of environmentally hazardous waste are encouraged to use the manifest. A manifest number is to be assigned in accordance for multiple shipments of similar wastes from a single generator, shipments of similar wastes from similar generators, emergency shipments, and unique wastes not identified in the yearly operating plan. The operator of the disposal site, after signing the manifest, shall send written notification of each manifest to the department at the time of delivery.

- Recordkeeping. The operator is to maintain survey records at the site for each burial trench and evaporation pond. These records are to include: the dimension of the trenches and ponds; its relation to the bench mark and monument; the volume and type of waste buried; and the dates of burial.

- Reporting. The operator of the disposal site is to include in the reports to the Department copies of all environmental sampling results during the previous quarter; telephone and written accounts of accidents or emergencies; financial reports; and copies of all written requests (including unnumbered manifests) for disposal.

- Inspection. The Department is authorized to inspect the disposal site and its facilities, to take samples of any waste, to sample by the drilling of test wells, and to inspect any records relating to the operation.

- Monitoring. Monitoring is required as indicated under Section WAC 173-302-280 and is specified in the yearly operational plan. Monitoring efforts of the site shall include that of on-site dry test well monitoring; burial trench and evaporation pond monitoring; sampling of particulates and gases; sampling of vegetation and resident vertebrate populations; and additional monitoring as specified in the operating plan.

- Enforcement. Enforcement of hazardous waste regulations is enumerated under Hazardous Waste Disposal, Section RCW 70.105.080. The authority of enforcement is carried out by the department, and is enforceable under penalty.

A.4 Examples of Other State Control Mechanisms

This section discusses selected examples of mechanisms used by states to control hazardous wastes in the absence of specific hazardous waste legislation.

A.4.1 Nebraska. There were no regulations as of 1978 specifically for the disposal of hazardous wastes; however there were guidelines for the disposal of pesticides, pesticide containers, and pesticide-related materials. For the disposal of large amounts of pesticides or pesticide-related wastes, the Department of Environmental Control must be notified in writing of the type, amount, composition, containerization, and location of pesticide-related materials. The Department then selects a location for disposal and devises an operational plan to be followed by the operator of the site. If no sites within the State are able to handle the wastes, the Department then advises the generator about out-of-state sites (State of Nebraska, 1977).

A.4.2 Utah. Although there was no legislation as of 1978 specifically for the management of hazardous wastes, Utah has developed an interpretation of the solid waste disposal regulations for hazardous and special waste disposal. Basically, this interpretation provides that a hazardous waste disposal area may be designated within a sanitary landfill providing adequate measures are taken to protect the public, the operating personnel, and the environment. Issuance of approval for disposal of hazardous waste depends on the physical location of the hazardous waste disposal area so as to avoid interfering with normal landfill operations, including the proper attention to pertinent geological data. Precautions are to be taken to protect the public from inadvertent exposure to hazardous or contaminated wastes and to protect all surface and groundwaters. Long-range plans are required to ensure that deposited wastes will not require relocation at a future time.

Optional requirements for the disposal of hazardous wastes consider the type of waste, total volume, solubility, volatility, presence of noxious fumes, degradation rates, and related factors. A permanent record is to be kept by the responsible agency containing information on the exact composition, amounts, and location of deposited hazardous wastes. Accidents, spills, exposure to chemicals or insecticides, or disturbance of buried hazardous wastes must be reported to the local health department and the State Division of Health (State of Utah, 1974).

A.5 Hazardous Waste Legislation for the U.S. Territories

A.5.1 Territory of Guam. The territorial statutes affecting hazardous waste management include (Garretson et al., 1978):

- Public Law 14-37. This law defines hazardous wastes and authorizes an investigation to set standards for the storage, treatment, and disposal of such wastes. Handling of hazardous waste in any manner that would degrade the environment or create a health or safety problem is prohibited.

- Draft Pesticide Regulations. This regulation (based upon the U.C. Guam Pesticide Act) prohibits storage or disposal of pesticides in any manner that might create a hazard. Reusable empty containers may only be refilled with the same pesticide that was initially contained, unless authorized for other reuse by the Administrator, Guam Environmental Protection Agency; and unusable empty containers must be cleaned, crushed, and buried at least one foot deep and away from any ground water supply.

A.5.2 Territory of American Samoa. The territorial statutes affecting hazardous waste management include (Garretson et al. 1978):

- Title 13 - Conservation, Chapter 1, Environmental Quality Act. This act is designed to achieve and maintain levels of air and water quality that will protect human health and safety and prevent injury to plant and animal life and property. The act establishes an Environmental Quality Commission and confers upon it the authority to adopt regulations implementing this chapter.

- Title 20 - Harbors and Navigations, Chapter 13, Health and Safety, Section 1411. This section probits the discharge of refuse, sludge, acid, or any other matter of any kind into any harbor or stream flowing into the harbor. Section 1412 prohibits the discharge to any harbor of oil sludge, waste oil, fuel oil, bilge water, or any other waste which may cause contamination of harbor waters.

A.5.3 Trust Territory of the Pacific Islands. The territorial statutes affecting hazardous waste management include (Garretson et al., 1978):

- Public Law 4C-78 (63 TTC 505 et seq.). This law grants authority to the Trust Territory Environmental Protection Board to promulgate regulations with respect to air, land, and water pollution.

- Title 63, Chapter 13, Subchapter IV, Trust Territory Pesticide Regulations. This regulation prohibits the use, storage, transportation, mixing, or discarding of any pesticide or pesticide container in any manner which would adversely affect the environment.

A.5.4 Puerto Rico.

- Enabling legislation was approved under the "Puerto Rico Solid Waste Management Authority Act" on June 23, 1978. Included in the authority of this act is the provision to regulate facilities for the processing, recovery, and disposal of toxic or hazardous solid waste (Commonwealth of Puerto Rico, 1978).

A.5.5 The U.S. Virgin Islands. The territorial statutes affecting hazardous waste management include (Territory of the Virgin Islands of the United States, 1978):

- (Bill No. 7932) Proposed Amendments to "Solid and Hazardous Waste Management," Title 19, Chapter 56. Hazardous wastes are specifically addressed under Section 1558. The enabling authority to regulate hazardous wastes is directed to the Commission of Public Works. Authority over the storage, transport, and disposal is specifically indicated, and the authority to develop regulations including criteria for and listing of hazardous wastes, standards, permit requirements, and authority over both on and off-site waste generation is included.

- Within the various other sections of the Act is the authority to issue permits, require recordkeeping, inspect a facility, and enforce any rule or regulation under the penalty of fine and/or imprisonment. The authority to require a manifest is also within the scope of the Act.

APPENDIX B
BASELINE SUBTITLE C REGULATIONS

SUBPART A - CRITERIA, IDENTIFICATION, AND LISTING OF HAZARDOUS WASTE

250.10 Purpose and Scope

250.11 Definitions

250.12 Criteria

- (a) Identifying Characteristics
- (b) Listing
- (c) Applicability

250.13 Hazardous Waste Characteristics

- (a) Characteristics
    - (1) Ignitable Waste
    - (2) Corrosive Waste
    - (3) Reactive Waste
    - (4) Toxic Waste
- (b) Identification Methods
    - (1) Ignitable Waste
    - (2) Corrosive Waste
    - (3) Reactive Waste
    - (4) Toxic Waste
    - (5) Sampling Methods

250.14 Hazardous Waste Lists

- (a) Lists
    - (1) Hazardous Wastes
    - (2) Hazardous Waste Processes and Sources
- (b) Relief from Listing

250.10 PURPOSE AND SCOPE

(a) These regulations are published pursuant to Section 3001 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (42 USC 6921) which requires the Administrator to designate criteria for identifying characteristics of hazardous waste and for listing hazardous wastes, to identify such characteristics for, and to list, hazardous wastes.

(b) The purpose of this regulation is to describe the characteristics and lists against which a waste generator, transporter, or owner/operator of a waste treatment, storage, or disposal facility must determine if the waste he handles is a hazardous waste subject to the regulations of this Part.

(c) Any person who generates, transports, treats, stores, or disposes of a waste, which is ignitable, corrosive, reactive, or toxic (as defined in this Subpart), or which is listed in Section 250.14 of this Subpart, or who elects to consider his waste to be hazardous, shall comply with the regulations of this Part, in the transport, storage, treatment, handling, and disposal of that waste, except as noted below:

(1) Agricultural wastes including manures and crop residues, which are returned to the soil as fertilizers or soil conditioners are not subject to these regulations.

(2) Overburden resulting from mining operations and intended for return to the mine is not subject to these regulations.

(3) Pursuant to Section 1006 of the Act (42 USC 6905), for the purpose of administrative efficiency, sewage sludge from publicly owned treatment works which is managed pursuant to the guidelines of Section 405(b) and (d), of the Clean Water Act, in a manner consistent with the goals and policies expressed in the Act and its associated regulations, is not subject to these regulations.

250.11 DEFINITIONS

For the purpose of this subpart, all terms not defined herein take the meaning given in the Act. (Some terms (marked by *) are repeated from the Act for the convenience of the reader.)

(a)* The term "disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

(b) The term "equivalent method" means any testing method which the Administrator determines to be functionally equivalent to the method specified.

(c)* The term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical chemical, or infectious characteristics may -

(1) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

(d) The term "other discarded material" in 250.11(g) means any material which:

(1) is not re-used (that is, is abandoned or committed to final disposition), or

(2) re-used

(i) if such use constitutes disposal (as defined herein), or

(ii) if listed below:

(A) used lubricating, hydraulic, transmission, transformer, or cutting oil unless such oil meets the requirements of 250.45-7.

(e) The term "publicly owned treatment works" or "POTW" means a treatment works as defined by Section 212 of the Clean Water Act (CWA), which is owned by a State or municipality (as defined by Section 582(4) of the CWA). This definition includes any sewers that convey wastewater to such a treatment works, but does not include pipes, sewers or other conveyances not connected to a facility providing treatment. The term also means the municipality as defined in Section 502(4) of the CWA, which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

(f) The term "representative sample" means any sample of the waste which is statistically equivalent to the total waste in composition, and in physical and chemical properties.

(g)* The term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

(h) The term "triple rinsed" means the flushing of containers three times, each time using a volume of diluent at least equal to approximately ten percent of the container's capacity.

250.12 CRITERIA

(a) Identifying Characteristics

The characteristics of hazardous waste set out in Section 250.13 may be identified using the following criteria:

(1) identification of the characteristic in the Act

(2) damage incident(s) indicating that the characteristic is harmful to human health or the environment

(3) identification of the characteristic by other organizations which regulate or recommend management methods for hazardous substances.

(4) significance of the hazard posed by the characteristic

(5) availability of test protocols for the presence of the characteristic

(b) Listing

(1) A solid waste may be listed as hazardous under any of the following conditions:

(A) The solid waste has any of the characteristics defined in this Subpart.

(B) The solid waste causes or significantly contributes to an increase in serious irreversible, or incapacitating reversible, illness.

(C) The solid waste may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

(2) The petition by a State governor (under Section 3001(c) of Pub. L. 94-580) or by a person (under Section 7004(a) of Pub. L. 94-580) to list a waste may be granted.

250.13 HAZARDOUS WASTE CHARACTERISTICS

(a) Characteristics

(1) Ignitable Waste - A solid waste is an ignitable waste if a representative sample of that waste:

(i) In a liquid state has a flash point less than 60 C (140 F) determined by the method cited in Section 250.13(b) of this Subpart or an equivalent method; or under conditions incident to the management of the waste from which the sample was taken is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes, or retained heat from manufacturing or processing; or when ignited burns so vigorously and persistently as to create a hazard during its management.

(ii) is a compressed gas as defined in 49 CFR 173.300, or

(iii) is an oxidizer as defined in 49 CFR 173.151.

(2) Corrosive waste - A solid waste is a corrosive waste if a representative sample of the waste:

(i) is aqueous and has a pH less than or equal to 3 and greater than or equal to 12 as determined by the method cited in Section 250.13(b) or an equivalent method, or

(ii) has a corrosion rate greater than 0.250 inch per year on steel (SAE1020) at a test temperature of 130 F as determined by the method cited in Section 250.13(b) or an equivalent method.

(3) Reactive Waste - A solid waste is a reactive waste if it:

(i) Is normally unstable and readily undergoes violent chemical change but does not detonate; reacts violently with water, forms potential explosive mixtures with water, or generates toxic fumes when mixed with water; or is a cyanide or sulfide bearing waste which might generate toxic fumes under mildly acidic or basic conditions.

(ii) is capable of detonation or explosive reaction but requires a strong initiating source or which must be heated under confinement before initiation can take place, or which reacts explosively with water.

(iii) is readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.

(iv) is a forbidden explosive as defined in 49 CFR 173.51, Class A explosive as defined in 49 CFR 173.53, or Class B explosive as defined in 49 CFR 173.58.

> NOTE: Such wastes include pyrophoric substances, explosives, autopolymerizable material and oxidizing agents. If it is not apparent whether a waste is a reactive waste using this description, then the methods cited in 250.13(b) of this chapter or equivalent methods can be used to determine if the waste is reactive waste.

(4) Toxic Waste - A solid waste is a toxic waste if, according to the methods specified in 250.13(b), the extract obtained from applying the extraction procedure (EP) to a representative sample of the waste:

(i) Has a concentration of any substance for which an EPA Primary Drinking Water Standard has been established, which is greater than or equal to 10 times that standard, as shown below:

Contaminant	Drinking Water Level, Milligrams per Liter	Extract Level, Milligrams per Litre
Arsenic	0.05	0.50
Barium	1.	10.
Cadmium	0.010	0.10
Chromium	0.05	0.50
Lead	0.05	0.50
Mercury	0.002	0.02
Selenium	0.01	0.10
Silver	0.05	0.50
Endrin (1,2,3,4,10,10-hexacloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5, 8-dimethano naphthalene).	0.0002	0.002
Lindane (1,2,3,4,5,6-hexachlorocyclohexane gamma isomer).	0.004	0.040
Methoxychlor (1,1,1-Trichloroethane). 2,2-bis (p-methoxyphenyl)	0.1	1.0
Toxaphene ($C_{10}H_{10}Cl_8$-technical chlorinated camphene, 67-69 percent chlorine).	0.005	0.050
2,4-D, (2,4-Dichlorophenoxyacetic acid).	0.1	1.0
2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid).	0.01	0.10

(b) Identification Methods

(1) Ignitable Waste

(i) Flash point of liquids shall be determined by a Pensky-Martens Closed Cup Tester, using the protocol specified in ASTM Standard D-93-72, or the Setaflash Closed Tester using the protocol specified in ASTM standard D-3278-73 or any other equivalent method as defined in this Subpart.

(ii) Ignitable gases shall be determined by the methods described in 49 CFR 173.300.

(2) Corrosive Waste

(i) pH shall be determined by a pH meter, using the protocol specified in the "Manual of Methods for Chemical Analysis of Water and Wastes" (EPA-625-16-74 003).

(ii) Rate of metal corrosion shall be determined using the protocol specified in NACE (National Association of Corrosion Engineers) Standard TM-01-69.

(3) Reactive Waste

(i) Thermally unstable wastes can be identified using the Explosion Temperature Test cited in Appendix I (those wastes for which explosion ignition or decomposition occurs at 125 C after 5 minutes are classed as reactive wastes), or by using the Thermal Stability Test cited in 49 CFR 173.51a.

(ii) Wastes unstable to mechanical shock can be identified using the Bureau of Mines Impact Test (U.S. Bureau of Mines Bulletin 346 (1931), at a 25cm drop height, or the test cited in 49 CFR 173.53(b).

(4) Toxic Waste

(i) Extraction Procedure

(A) Equipment

(I) An agitator which while preventing stratification of sample and extraction fluid, also insures that all sample surfaces are continuously brought into contact with well-mixed extraction fluid. (One suitable device is Associated Design and Mfg. Co. Part _____, Alexandria, VA 22314).

(II) Equipment suitable for maintaining the pH of the extraction medium at a selected value.

(B) Procedure

(I) Take a representative sample (minimum size 100 gms) of the waste to be tested. Separate sample into liquid and solid phases. The solid phase is defined as that fraction which does not pass through a 0.4-0.5 micron filter medium under the influence of either pressure, vacuum, or centrifugal force. (See Appendix II for specific separation protocols.) Reserve the liquid fraction under refrigeration 1-5 C (34-41 F) for further use.

(II) The solid portion of the sample, resulting from the separation procedure above or the waste itself (if it is already dry), shall be prepared either by grinding to pass through a 9.5mm (3/8") standard sieve or by subjecting it to the structural integrity procedure, as described in Appendix III.

(III) Add the solid material from paragraph II to 16 times its weight of deionized water. This water should include any water used during transfer operations. Begin agitation and extract the solid for 24 ± 0.5 hours. Adjust the solution to pH5 and maintain that pH during the course of the extraction using 0.5N acetic acid, (see Appendix IV). If more than 4 ml of acid, for each gm of solid would be required to maintain the pH at 5, then once 4 ml per gram of solid has been added, complete the 24 hour extraction without adding any additional acid. Maintain the sample between 20-30 C (68-86 F) during extraction.

(IV) At the end of the 24 hour extraction period, separate the sample into solid and liquid phases as in Paragraph I. Adjust the liquid phase with deionized water so that its volume is 20 times that occupied by a quantity of water at 4 C equal in weight to the initial sample of solid (e.g., for an initial sample of 1g, dilute to 20ml). Combine this liquid with the original liquid phase of the waste. This combined liquid, including precipitate which later forms from it, is the Extraction Procedure extract.

(ii) Analysis - Analyses conducted to determine conformance with Section 250.13(a)(4) shall be made in accordance with the following or equivalent methods:

(A) Arsenic - Atomic Absorption Method, "Methods for Chemical Analysis of Water and Wastes," pp. 95-96, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(B) Barium - Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 97-98, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(C) Cadmium - Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 101-103, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(D) Chromium - Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 112-113, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(E) Lead - Atomic Absorption Method, "Standard Methods for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," pp. 112-113, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(F) Mercury - Flameless Atomic Absorption Method, "Methods for Chemical Analysis of Water and Wastes," pp. 118-126, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460.

(G) Selenium - Atomic Absorption Method, "Methods for Chemical Analysis of Water and Wastes," p. 145, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(H) Silver - Atomic Absorption Method, "Standard Method for the Examination of Water and Wastewater," 13th Edition, pp. 210-215, or "Methods for Chemical Analysis of Water and Wastes," p. 146, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

(I) Analyses made for Endrin, Lindane, Methoxychlor, or Toxaphene shall be in accordance with "Method for Organochlorine Pesticides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(J) Analyses for 2,4-D and 2,4,5-TP Silvex shall be conducted in accordance with "Methods for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(5) Sampling Methods: Methods for generating representative samples of wastes to be tested are set out in Appendix V.

250.14 HAZARDOUS WASTE LISTS

(a) Lists

Any waste listed in 250.14(a)(1) or 250.14(a)(2) of this section is a hazardous waste unless the generator can prove the waste does not meet the criteria for listing in this Subpart (i.e., I = Ignitable, C = Corrosive, R = Reactive, T = Toxic, AD = Administrator's judgment) using the Test or identification methods described in 250.14(b) of this Subpart or equivalent methods.

NOTE: The process waste streams are listed by SIC code for ease of reference only. The SIC classification of the industry generating the waste has no effect on the listing of that process waste as hazardous.

(1) Hazardous Wastes

Waste chlorinated hydrocarbons from degreasing operations (AD,I)

Waste nonhalogenated solvent (such as methanol, acetone, isopropyl alcohol, polyvinyl alcohol, stoddard solvent and methyl ethyl ketone) and solvent sludges from cleaning, compounding milling and other processes (I)

Hydraulic or cutting oil waste (T,AD)

Paint wastes (such as used rags, slops, latex sludge, spent solvent) (T,I,AD)

Water-based paint wastes (T)

Tank bottoms, leaded and unleaded (T,AD)

Cooling tower sludges (T)

Spent or waste cyanide solutions or sludges (R,T)

Etching acid solutions or sludges (T,C)

Waste paint and varnish remover or stripper (I)

Solvents and solvent recovery still bottoms (nonhalogenated (I,AD)

Solvents and solvent recovery still bottoms (halogenated) (AD)

Waste or waste off-spec toluene diisocyanate (I,R,AD)

Electroplating wastewater treatment sludge (T)

Pure material which is a discarded material and is listed in Appendix VI, VII, and XIV (AD)

Spill clean-up residues and debris from spills of materials which appear in Appendix VI, VII, and XIV (AD)

Off-specification material which is a discarded material and, if met specification, would be shipped using a name listed in Appendix VI, VII, and XIV (AD)

Containers, unless triple rinsed, which have contained materials on Appendix VI, VII and XIV (AD)

(2) Hazardous Waste Processes and Sources

(i) Sources Generating Hazardous Waste

(A) Health Care Facilities

(I) The following departments of hospitals as defined by SIC* Codes 8062 and 8069, unless the waste has been autoclaved as specified in Appendix VIII. (AD(IN))

i. Obstetrics department including patients' rooms
ii. Emergency departments
iii. Surgery department including patients' rooms
iv. Morgue
v. Pathology department
vi. Autopsy department
vii. Isolation rooms
viii. Laboratories
ix. Intensive care unit
x. Pediatrics department

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*Standard Industrial Classification Manual (1972) GPO, Washington, D.C.

(II) The following departments of veterinary hospitals as defined by SIC[*] Codes 0741 and 0742, unless the waste has been autoclaved as specified in Appendix VIII. (AD(IN)).

- i. Emergency department
- ii. Surgery department including patients' rooms
- iii. Morgue
- iv. Pathology department
- v. Autopsy department
- vi. Isolation rooms
- vii. Laboratories
- viii. Intensive care unit

(B) Laboratories, as defined by SIC Codes 7391, 8071 and 8922, unless the laboratories do not work with CDC Classes 2 through 5 of Etiologic Agents as listed in Appendix IX. (AD(IN)).

(C) Sewage Treatment Plants, with the exception of publicly owned treatment works, unless sludge generated by such a plant has been stabilized by means of chemical, physical, thermal, or biological treatment processes that result in the significant reduction of odors, volatile organics and pathogenic microorganisms. These processes are discussed in "Municipal Sludge Management: Environmental Factors; Technical Bulletin" (42 FR 57420). Specifications for the stabilization processes discussed in this publication are given in Process Design Manual for Sludge Treatment and Disposal, (EPA 625/1-1-74-006, October 1974). (AD(IN)).

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[*] Standard Industrial Classification Manual (1972) GPO, Washington, D.C.

Unless the waste from these sources does not contain microorganisms or helminths of CDC Classes 2 through 5 of the Etiologic Agents listed in Appendix IX.

(ii) Processes Generating Hazardous Wastes:

SIC	Process Description
1099	Waste rock and overburden from uranium mining (AD(RA))
1099	Mill tailings from uranium milling (AD(RA))
1499	Overburden, slimes and tailings from phosphate surface mining (AD(RA))
1499	Waste gypsum from phosphoric acid production (AD(RA))
1499	Slag and fluid bed frills from elemental phosphorous production (AD(RA))
2231	Wool Fabric Dying and Finishing Wastewater treatment sludges (T)
2241	Wool Fabric Dying and Finishing Wastewater treatment sludges (T)
2250	Knit Fabric Dying and Finishing Wastewater treatment sludges (T)
2269	Yarn and Stock Dying and Finishing Wastewater treatment sludges (T)
2279	Carpet Dying and Finishing Wastewater treatment sludges (T)
2299	Wool Scouring Wastewater treatment sludges (T)
2812	Mercury bearing sludges from brine treatment from mercury cell process in chlorine production (T)

SIC	Process Description
2812	Sodium calcium sludge from production of chlorine by Down Cell process (R)
2812	Mercury bearing brine purification muds from mercury cell process in chlorine production (T)
2812	Waste water treatment sludge from diaphragm cell process in production of chlorine (T)
2812	Asbestos wastes from cell diaphrams in production of chlorine (AD)
2812	Chlorinated hydrocarbon bearing wastes from diaphragm cell process in chlorine production (AD)
2816	Chromium bearing wastewater treatment sludge from production of chrome green pigment (T)
2816	Chromium bearing wastewater treatment sludge and other chromium bearing wastes from production of chrome oxide green pigment (anhydrous & hydrated) (T)
2816	Ferric ferrocyanide bearing wastewater treatment sludges from the production of iron blue pigments (T)
2816	Mercury bearing wastewater treatment sludges from the production of mercuric sulfide pigment (T)
2816	Chromium bearing wastewater treatment sludges from the production of TiO_2 pigment by the chloride process (T)
2816	Chromium bearing wastewater treatment sludges from the production of TiO_2 pigment by sulfate process (T)
2816	Arsenic bearing sludges from purification process in the production of antimony oxide (T)
2816	Antimony bearing wastewater treatment sludge from production of antimony oxide (T)
2816	Chromium or lead bearing wastewater treatment sludge from production of chrome yellows and oranges (lead chromate) (T)
2816	Chromium or lead bearing wastewater treatment sludge from production of molybdate orange (lead chromate) (T)

SIC	Process Description
2816	Zinc and chromium bearing wastewater treatment sludge from production of zinc yellow pigment (hydrated zinc potassium chromate) (T)
2816	Ash from incinerated still bottoms (Paint and Pigment Production) (T)
2819	Arsenic bearing waste water treatment sludges from production of boric acid (T)
2851	Wastewater treatment sludges from paint production (C,T)
2851	Air pollution control sludges from paint production (T)
2865	Vacuum still bottoms from the production of maleic anhydride (AD)
2865	Still bottoms from distillation of benzyl chloride (AD)
2865	Distillation residues from fractionating tower for recovery of benzene and chlorobenzenes (AD)
2865	Vacuum distillation residues from purification of 1 - chloro - 4 nitrobenzene (AD)
2865	Still bottoms or heavy ends from methanol recovery in methyl methacrylate production (AD)
2869	Heavy ends (still bottoms) from fractionator in production of epichlorohydrin (AD)
2869	Heavy chlorinated organics from fractionation in ethyl chloride production (AD)
2869	Column bottoms or heavy ends from production of trichloroethylene (AD)
2869	Heavy ends from distillation of vinyl chloride in production of vinyl chloride from ethylene dichloride (AD)
2869	Heavy ends from distillation of ethylene dichloride in vinyl chloride production from ethylene dichloride (AD)
2869	Heavy ends or distillation residues from carbon tetrachloride fractionation tower (AD)

SIC	Process Description
2869	Purification column wastes from production of nitrobenzene (AD)
2869	Still bottoms from production of furfural (I,AD)
2869	Spent catalyst from fluorocarbon production (AD)
2869	Centrifuge residue from toluene diisocyanate production (AD)
2869	Lead slag from lead alkyls production (T)
2869	Stripping still tails from production of methylethyl pyridines (I,AD)
2869	Still bottoms from aniline production (AD)
2869	Aqueous effluent from scrubbing of spent acid in nitro benzene production (AD)
2869	Bottom stream from quench column acrylonitrile production (AD,I)
2869	Bottom stream from wastewater stripper in production of acrylonitrile (I,C,AD)
2869	Still bottoms from final purification of acrylonitrile (I,AD)
2869	Solid waste discharge from ion exchange column in production of acrylonitrile (I,AD)
2869	Stream from purification of HCN in production of acrylonitrile (AD,I)
2869	Waste stream (column bottoms) from acetonitrile purification in production of acrylonitrile (AD)
2890	Sludges, wastes from tub washer (Ink Formulation) (AD)
2892	Wastewater treatment sludges from explosives, propellants and initiating compounds manufacture (C,AD,R,I)
2892	Wastes recovered from acid vapor scrubber stream in the production of RDX/HMX (AD,R,I)

SIC	Process Description
2892	Catch basin materials in RDX/HMX production (T,C)
2892	Spent carbon columns used in treatment of wastewater-LAP operations (R)
2892	Wastewater sludges from production of initiating compounds (T)
2892	Red water from TNT production (T)
2911	Petroleum refining, high octane production neutralization HF alkylation sludge (T)
2911	Petroleum refining DAF sludge (T,I)
2911	Petroleum refining kerosene filter cakes (T)
2911	Petroleum refining lube oil filtration clays (T)
2911	Petroleum refining - slop oil emulsion solids (T,I)
2911	Petroleum refining exchange bundle cleaning solvent (T)
2911	API separator sludge (T)
3111	Leather tanning and finishing: Wastewater treatment sludge from; chrome tannery, split tannery, beamhouse/tanhouse and retan/finishers (T)
3111	Leather tanning and finishing: Wastewater treatment screenings from sheepskin tannery (T)
3111	Trimmings and shavings from leather tanning and finishing chrome, split, beam/tanhouse and retan/finishers (T)
3312	Coking: Decanter tank tar (T) : Decanter tank pitch sludge (T) : Oleum wash waste (C) : Caustic neutralization waste (C)
3312	Iron Making: Ferromanganese blast furnace dust (T,R) : Ferromanganese blast furnace sludge (T)
3312	Steel Finishing: Alkaline cleaning waste (C) : Waste pickle liquor (C) : Cyanide-bearing wastes from electrolytic coating (T) : Chromates and dichromates from chemical treatment (T)

SIC	Process Description
3331	Primary copper smelting and refining electric furnace slag, converter dust, acid plant sludge, and reverbatory dust (T)
3332	Primary lead - acid plant blowdown and lime treatment sludge from lagoon dredging (T)
3333	Zinc acid plant blowdown lime treatment: gypsum cake (acid cooling tower and neutral cooling tower) (T)
3333	Zinc production: oxide furnace residue and acid plant sludge (T)
3333	Zinc anode sludge (T)
3339	Primary antimony - electrolytic sludge (T)
3339	Primary tungsten - digestion residues (T)
3339	Primary lead sinter dust scrubbing sludge (T)
3339	Ferromanganese emissions control: baghouse dusts and scrubwater solids (T)
3339	Ferrochrome emissions control: furnace baghouse dust and ESP dust (T)
3339	Ferronickel production: skull plant tailings (T)
3339	Primary antimony - pyrometallurgical blast furnace slag (T)
3341	Secondary lead, scrubber sludge from SO_2 emission control, soft lead production (T)
3341	Secondary lead - white metal production furnace dust (T)
3341	Secondary copper - pyrometallurgical, blast furnace slag (T)
3341	Secondary aluminum dross smelting - high salt slag plant residue (T)
3341	Zinc - cadmium metal reclamation, cadmium plant residue (T)
3471	Electroplating wastewater treatment sludges (T)

SIC	Process Description
3691	Lead acid storage battery production wastewater treatment sludges (T)
3691	Lead acid storage battery production clean-up wastes from cathode and anode paste production (T)
3691	Nickel cadmium battery production wastewater treatment sludges (T)
3691	Cadmium silver oxide battery production wastewater treatment sludge (T)
3691	Mercury cadmium battery production wastewater treatment sludges (T)
3692	Magnesium carbon battery production chromic acid wastewater treatment sludges (T)

(b) Relief from Listing

(1) Scope and Purpose

(A) This section applies to any person handling a waste listed in Section 250.14(a) who wishes to demonstrate that his solid waste is not a hazardous waste.

(B) A waste listed in 250.14(a) for one or more reasons, as indicated by the codes (I), (C), (R), (AD(IN)), etc. is a hazardous waste unless it is demonstrated that the waste does not meet the reason(s) shown for its listing.

(C) The methods for demonstration of this are described in 250.14(b)(3).

(D) (Reserved.)

(2) Test Methods

Wastes from individual generators which meet the following standards are to be considered non-hazardous for purposes of this regulation:

(A) Wastes designated as ignitable (I) in 250.14(a) which do not meet the 250.13(a)(1) ignitable characteristic.

(B) Wastes designated as corrosive (C) in 250.14(a) which do not meet the 250.13(a)(2) corrosive characteristic.

(C) Wastes designated as reactive (R) in 250.14(a) which do not meet the 250.13(a)(3) reactive characteristic.

(D) Wastes designated as toxic (T) in 250.14(a) which do not meet the 250.13(a)(4) toxic characteristic.

(E) Wastes designated as infectious (AD(IN)) in 250.14(a) which do not contain microorganisms or helminths of CDC Classes 2 through 5 of the Etiologic Agents listed in Appendix IX.

(F) Wastes designated as radioactive (AD-(RA)) in 250.14(a) which have neither of the following properties:

(i) An average radium-226 concentration equal to or more than 5 picocuries per gram for solid wastes or 50 picocuries (radium-226 and radium-228 combined) per liter for liquid wastes as determined by either of the methods cited in Appendix X; or

(ii) A total radium-226 activity equal to or more than 10 microcuries for any single discrete source.

(G) Wastes otherwise designated as being hazardous in the Administrator's judgment (AD) in Section 250.14(a) which do not meet the toxic characteristics of Section 250.13(a) and whose EP extract does not have any of the following properties:

(i) Gives a positive response in any one of a set of required tests for mutagenic activity. A total of three assays must be conducted. One shall be chosen from group I, one from group II, and one from those listed in group III. Test protocols are defined in Appendix XI.

(I) Detection of gene mutations.

I. Point mutation in bacteria.

(II) Detection of gene mutations.

I. Mammalian somatic cells in culture

II. Fungal microorganisms

(III) Detecting effects on DNA repair or recombination as an indication of genetic damage.

I. DNA repair in bacteria (including differential killing of repair defective strains).

II. Unscheduled DNA synthesis in human diploid cells.

III. Sister-chromatid exchange in mammalian cells.

IV. Mitotic recombination and/or gene conversion in yeast.

(ii) Gives a positive result in the Bioaccumulation Potential Test, defined in Appendix XII.

(iii) Contains more than the specified concentration of any compound on the Controlled Substances list in Appendix XIII.

(iv) Contains any organic substance which has a calculated human LD50* of less than 800 mg/kg, at a concentration in mg/l greater than or equal to 0.35 times its LD50 expressed in units of mg/kg. For purposes of these regulations metallic salts of organic acids containing 3 or fewer carbon atoms are considered not to be organic substances.

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*Procedure for Calculating Human LD50 Value:

The LD50 value to be used will be those for oral exposure to rats. Where a value for the rat is not available, mouse oral LD50 data may be employed. Where an appropriate LD50 value for the rat or mouse is listed in the NIOSH Registry of Toxic Effects of Chemical Substances ("Registry"), this value may be used without validation. If other values are used, they must be supported by specific and verified laboratory reports. The appropriate conversion factor to use in calculation LD50s are:

Rat x .16 = human
Mouse x .066 = human

Example: Tetraethylenepentamine

Listed oral rat LD50 is 3990 mg/kg, calculated human LD50 is 3990 x 0.16 = 638 mg/kg; 638 x 0.35 = 223 mg/l.

Thus if the EP extract contains more than 223 mg/l of tetraethylenepentamine, the waste is hazardous.

APPENDIX I

EXPLOSION TEMPERATURE TEST*

1. Purpose of Test:

To determine the temperature at which a material explodes, ignites, or decomposes after a five minute immersion in a sand bath or dimethyl silicon at 125 C.

2. Operating Principle

This test gives an estimate of how close the explosion temperature is to ambient condition for a material, and, hence, provides a measurable indication of thermal instability.

3. Test Description

The material to be treated (25 mg.) is placed in a copper test tube (high thermal conductivity) and immersed in a sand or dimethyl silicon bath. The test is made at a series of bath temperatures, and the time lag prior to explosion at each temperature is recorded. The bath temperature is raised until a temperature of 125 C is reached if no explosion, ignition, or apparent decomposition occurs.

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* Taken from "A Second Appraisal of Methods for Estimating Self Reaction Hazards", E.S. Domalski, Report No. DOT/MTB/OHMO-76/6. Department of Transportation.

APPENDIX II

SEPARATION PROTOCOL

Filtration

Equipment:

1-Millipore YY22 142 30 filter holder (Millipore Corp., Bedford, MA 01730) equipped with an XX42 142 08 accessory 1.5 liter reservoir, or Nuclepore 420800 142mm filter holder (Nuclepore Corp., Pleasanton, CA 94566) equipped with a 1.5 liter reservoir, or Equivalent filter holder.

Procedure

A. Using the filter holder place a 0.45 micron filter membrane (Millipore type HAWP142, Nuclepore type 112007, or equivalent) on the support screen. On top of the membrane (upstream) place a prefilter (millipore AP25124, Nucleopore P040, or equivalent). Secure filter holder as directed in manufacturers instructions.

B. Fill the reservoir with the sample to be separated, pressurize to no more than 75 psi (7 kg/cm^2). Filter until no significant amount of fluid (5ml) is released during a 30 minute period.

C. After liquid flow stops, depressurize, open top of reservoir. If sample appears to contain significant amounts of liquid, replace filter pads as in step A, and resume filtering. Save pads for later use. Repeat this step until no more fluid can be removed from the waste.

D. Take the solid material, and any pads used in filtration, and extract in step 2 of the Toxicant Extraction Procedure. Subtract tare weights of filter pads in calculating the amount of solid material.

Centrifugation

Equipment

1. Centrifuge (i.e. Damon-IEC catalog no. 7165, Damon-IEC Corp., Needham Heights, MA, or equivalent) equipped with a rotor for 600 ml to 1 liter containers (Damon-IEC catalog no. 976, or equivalent). For flammable material containing wastes, explosion proof equipment, such as the Damon-IEC catalog number 8196 centrifuge is recommended.

2. Glass centrifuge bottles such as the Corning catalog 1252 600 ml blood bank centrifuge bottle or its equivalent.

Procedure

A. Centrifuge sample for 30 minutes at 2400 rpm. Hold temperature at 20-30 C (68-87 F).

B. Using a ruler, measure the size of the liquid and solid layers, to the nearest mm (0.40 inch). Calculate the liquid to solid ratio.

C. Repeat steps A and B until the solid to liquid ratio during two consecutive 30 minute centrifugations is within 3 percent.

D. Decant or siphon off the layers and extract the solid using step 2 of the Extraction Procedure.

APPENDIX III

STRUCTURAL INTEGRITY PROCEDURE

Equipment

1-Compaction tester having a 1.25 inch diameter hammer weighing 0.73 lbs. and having a free fall of 6 inches (Associated Design and Manufacturing Company, Alexandria, VA. 22314, catalog No. 125 or equivalent).

2-A sample holder prepared from a piece of flexible polyurethane foam having a 25 percent indentation load deflection of ___________ to ___________ lbs/sq. inch. (Figure 3)

Procedure

A. Fill the sample holder with the material to be tested. If the waste sample is a monolithic block, then cut out a representative sample from the block having the dimensions of a 1.3" X 2.8" cylinder.

B. Place the sample holder into the Compaction Tester and apply 12 hammer blows to the sample.

C. Remove the now compacted sample from the sample holder and transfer it to the extraction apparatus for extraction.

APPENDIX IV

pH ADJUSTMENT PROCEDURES

Automated

Follow manufacturer's instructions as to procedures for instrument calibration and operation.

Manual

This section prescribes the procedure to use if extractant pH is maintained manually.

1 - Calibrate pH meter in accord with manufacturer's specifications.

2 - Adjust pH of solution to 5.

3 - Manually adjust pH of solution at 15, 30, and 60 minute intervals moving to the next longer interval if the pH did not have to be adjusted more than 0.5 pH units since the previous adjustment.

4 - Continue procedure for a period of not less than 6 hours.

5 - Final pH after a 24 hour period must be within the range 4.9-5.2.

6 - If the conditions of 5 are not met, continue pH adjustment at approximately one hour intervals for a period of not less than 4 hours.

APPENDIX V

SAMPLING METHODS

The methods and equipment used for sampling waste materials will vary with the form and consistency of the waste material to be sampled. Listed below are sampling protocols appropriate for sampling wastes materials with consistencies similar to the indicated material.

Extremely viscous liquids - ASTM Standard D140-15

Crushed or powdered material - ASTM Standard D346-15

Soil or rock-like material - ASTM Standard D420-19

Soil-like material - ASTM Standard D1452-19

Fly ash-like material - ASTM Standard D2234-26

Additional protocols to be used are described in the draft report "Handbook for Sampling Hazardous Waste", Research Grant R-804692010, available from USEPA, Office of Solid Waste, Information-Materials Group, Cincinnati, Ohio 45268.

APPENDIX VI

PESTICIDES

BAAM (Amitraz)
Benomyl
BHC
Cadmium
Chlorobenzilate
Chloroform
DB CP
Diallate
Dimethoate
EBDC's
Endrin
Ethylene dibromide
Kepone
Lindane
Maleic hydrazide
PCNB
Pronamide
Strychnine/strychnine sulfate
1080/1081
2,4,5 - T
Thiophonate methyl
Toxaphene
Acrylonitrile
Creosot
DDVP
DEF
EPN
Erbon
Inorganic arsenicals
Merphos
Methanearsonates
Paraquat
Pentachlorophenol & Derivatives
Perthane
Piperonyl butoxide
Ronnel
Rotenone
Silvex
Treflan
Triallate
Trichlorofon
2,4,5 - Trichlorophenol
Aramite
Arsenic trioxide
Benzac
Chloranil
Copper acetoarsenite
Basic copper arsenate
Monuron
OMPA
10,10 - Oxybisphenoxarsine
Phenarsazine chloride
Safrole
Sodium arsenite
Strobane
Trysben
Chlordane/heptachlor
Picloram
Sperm oil
Lead acetate
Cacodylic acid and salts
Carbaryl
Carbon tetrachloride
Coal tar
Dacthal
Daminozide
Dichlorobenzene
1,3 - Dichloropropene
Dimilin
Dinoseb
Epichlorohydrin
Ethylene diamine tetra Acetic Acid
Folpet
Hexachlorobenzene
8 - Hydroxyquinoline
Maleic anhydride
Perchloroethylene
Phosphorus paste
Probe
Propham/chloropropham
Tribromosalan
Trichloroethylene
Zectran

Acrolein
Aldicarb
Allyl alcohol
Aluminum phosphide
Amitrole
Azinphos methyl
Calcium cyanide
Carbofuran
Carbon disulfide
Chlorfenvinphos
Chloropicrin
Clonitralid
Cycloheximide
Demeton
Dicrotophos
Dimethoate
Dioxathion
Diquat
Disulfoton
Endosulfan
Endothall
Ethoprop
Ethyl parathion
Ethyl 3 - methyl - 4 phenyl Phosphoramidate
Ethylene dibromide
Ethylene dichloride
Fensulfothion
Fenthion
Fluoracetamide/1081
Fonofos
Formaldehyde
Hydroocyanic acid
Methamidophos
Methidathion
Methomyl
Methyl bromide
Methyl parathion
Mevinphos
Monocrotophos
Nicotine
O,O - bis (p - chloro-phenyl) acetimidyol phosphoramidothioate
Oxyamyl
Oxydemeton methyl
Phorate
Phosphamidon
Phosphorus
Sodium fluoroacetate
Sulfotepp
Temephos
Tepp
Terbufos
Toxaphene
Xylene
Zinc phosphide

APPENDIX VII

DEPARTMENT OF TRANSPORTATION (DOT) CLASSIFICATION POISON A, POISON B, OR ORM-A

Note: *May or may not be regulated depending on whether or not commodity meets the DOT definition of the hazard class listed.

Acetaldehyde ammonia	ORM-A
Acetone cyanohydrin	B
Acetylene tetrabromide	ORM-A
Aldrin	B
Aldrin, cast solid	ORM-A
Aldrin mixture, dry (with more than 65% aldrin)	B
Aldrin mixture, dry (with 65% or less aldrin)	ORM-A
Aldrin mixture, liquid (with more than 60% aldrin)	B
Aldrin mixture, liquid (with 60% or less aldrin)	ORM-A
Allethrin	ORM-A
Ammonium arsenate, solid	B
Ammonium hydrosulfide solution	ORM-A
Ammonium polysulfide solution	ORM-A
Aniline oil drum, empty	B
Aniline oil, liquid	B
Antimony lactate, solid	ORM-A
Antimony potassium tartrate, solid	ORM-A
Antimony sulfide, solid	ORM-A
Arsenic acid, solid	B
*Arsenic acid, solution	B
*Arsenical compound, n.o.s.**, liquid, or arsenic mixture, n.o.s., liquid	B
*Arsenical compound, n.o.s., solid, or arsenical mixture, n.o.s., solid	B
Arsenical dip, liquid (sheep dip)	B
Arsenical dust	B
Arsenical flue dust	B
Arsenic bromide, solid	B
Arsenic iodide, solid	B
Arsenic pentoxide, solid	B
Arsenic, solid	B
Arsenic sulfide, solid	B
Arsenic trichloride, liquid	B

**n.o.s. = not otherwise specified

Arsenic trioxide, solid	B
*Arsenious and mercuric iodide solution	B
Arsine	A
Barium cyanide, solid	B
*Beryllium compound, n.o.s.	B
Bone oil	ORM-A
*Bordeaux arsenite, liquid	B
*Bordeaux arsenite, solid	A
Bromoacetone	A
Brucine, solid (dimethoxy strychnine)	B
Calcium arsenate, solid	B
Calcium arsenite, solid	B
Calcium cyanide, solid, or calcium cyanide mixture, solid	B
Camphene	ORM-A
Carbaryl	ORM-A
Carbolic acid, liquid or phenol, liquid (liquid tar acid containing over 50% benzophenol)	B
Carbolic acid, or phenol	B
Carbon tetrachloride	ORM-A
Chemical ammunition, nonexplosive (containing a Poison B material)	B
Chemical ammunition, nonexplosive (containing a Poison A material)	A
Chloroform	ORM-A
4-chloro-o-toluidine hydrochloride	B
Chloropicrin, absorbed	B
Chloropicrin and methyl chloride mixture	A
Chloropicrin, liquid	B
Chloropicrin mixture (containing no compressed gas or Poison A liquid)	B
Cocculus, solid (fishberry)	B
*Compound, tree or weed killing, liquid	B
Copper acetoarsenite, solid	B
Copper arsenite	B
Copper cyanide	B
*Cyanide or cyanide mixture, dry	B
Cyanogen bromide	B
Cyanogen chloride (containing less than 0.9% water)	A
Cyanogen gas	A
DDT	ORM-A
Diazinon	ORM-A
Dibromodifluoromethane	ORM-A
Dichlorobenzene, ortho, liquid	ORM-A
Dichlorobenzene, para, solid	ORM-A
Dichlorodifluorolthylene	ORM-A

Dichloromethane or methylene chloride	ORM-A
2,4 Dichlorophenoxyacetic acid	ORM-A
Dieldrin	ORM-A
Dinitrobenzene, solid or dinitrobenzol, solid	
*Dinitrobenzene solution	B
Dinitrochlorobenzol, solid or dinitrochlorobenzene	B
Dinitrocyclohexylphenol	ORM-A
*Dinitrophenol solution	B
*Disinfectant, liquid	B
*Disinfectant, solid	B
*Drugs, n.o.s., liquid	B
*Drugs, n.o.s., solid	B
Ethylene chlorohydrin	B
Ethylene dibromide (1,2-dibromomethane)	ORM-A
Ferric arsenate, solid	B
Ferric arsenite, solid	B
Ferrophosphorus	ORM-A
Ferrosilicon, containing 30% or more but not more than 70% silicon	ORM-A
Ferrous arsenate (iron arsenate), solid	B
Flue dust, poisonous	B
Formaldehyde, or formalin solution (in containers of 110 gallons or less)	ORM-A
*Gas identification set	A
Germane	A
Grenade without bursting charge: with Poison A gas charge	A
Grenade without bursting charge: with Poison B gas charge	B
Hexachloroethane	ORM-A
Hexaethyl tetraphosphate and compressed gas mixture	A
Hexaethyl tetraphosphate, liquid	B
Hexaethyl tetraphosphate mixture, dry (containing more than 2% hexaethyl tetraphosphate)	B
*Hexaethyl tetraphosphate mixture, dry (containing not more than 2% hexaethyl tetraphosphate)	B
Hexaethyl tetraphosphate mixture, liquid (containing more than 25% hexaethyl tetraphosphate)	B
*Hexaethyl tetraphosphate mixture, liquid (containing not more than 25% hexaethyl tetraphosphate)	B
Hydrocyanic acid, liquified	A
Hydrocyanic acid (prussic), solution (5% or more hydrocyanic acid)	A
Hydrocyanic acid solution, less than 5% hydrocyanic acid)	B
*Insecticide, dry, n.o.s.	B
Insecticide, liquified gas, containing Poison A material or Poison B material	A

*Insecticide, liquid, n.o.s.	B
Lead arsenate, solid	B
Lead arsenite, solid	B
Lead cyanide	B
Lindane	ORM-A
London purple, solid	B
Magnesium arsenate, solid	B
Malathion	ORM-A
*Medecines, n.o.s., liquid	B
*Medecines, n.o.s., solid	B
*Mercaptan mixture, aliphatic (in containers (of 110 gallons or less)	ORM-A
Mercuric acetate	B
Mercuric-ammonium chloride, solids	B
Mercuric benzoate, solid	B
Mercuric bromide, solid	B
Mercuric chloride, solid	B
Mercuric cyanide, solid	B
Mercuric iodide, solid	B
*Mercuric iodide solution	B
Mercuric oleate, solid	B
Mercuric oxide, solid	B
Mercuric oxycyanide, solid	B
Mercuric-potassium cyanide, solid	B
Mercuric-potassium iodide, solid	B
Mercuric salicylate, solid	B
Mercuric subsulfate, solid	B
Mercuric sulfate, solid	B
Mercuric sulfocyanate, solid or mercuric thiocyanate, solid	B
Mercurol, or mercury nucleate, solid	B
Mercurous acetate, solid	B
Mercurous bromide, solid	B
Mercurous gluconate, solid	B
Mercurous iodide, solid	B
Mercurous oxide, block, solid	B
Mercurous sulfate, solid	B
*Mercury compound, n.o.s., solid	B
Methyl bromide and ethylene dibromide mixture, liquid	B
Methyl bromide and more than 2% chloropicrin mixture, liquid	B
Methyl bromide and nonflammable, nonliquified compressed gas mixture, liquid (including up to 2% chloropicrin)	B
Methyl bromide, liquid (bromoethane) including up to 2% chloropicrin	B
Methyl chloroform	ORM-A

Methyldichloroarsine	A
Methyl parathion, liquid	B
*Methyl parathion mixture, dry	B
*Methyl parathion mixture, liquid, (containing 25% or less methyl parathion)	B
Methyl parathion mixture, liquid, (containing over 25% methyl parathion)	B
Mipafox	ORM-A
Motor fuel antiknock compound, or antiknock compound	B
Napthalene or napthalin	ORM-A
Nickel cyanide, solid	B
Nicotine hydrochloride	B
Nicotine, liquid	B
Nicotine salicylate	B
*Nicotine sulfate, liquid	B
Nicotine tartrate	B
Nitric oxide	A
Nitroaniline	B
Nitrobenzol, liquid (oil or mirbane, nitrobenzene)	B
Nitrochlorobenzene, ortho, liquid	B
Nitrochlorobenzene, meta or para, solid	B
Nitrogen dioxide, liquid	A
Nitrogen peroxide, liquid	A
Nitrogen tetraoxide, liquid	A
Nitroxylol	B
*Organic phosphate, organic phosphate compound, or organic phosphorus compound; mixed with compressed gas	A
*Organic phosphate, organic phosphate compound; or organic phosphorus compound; liquid	B
*Organic phosphate, organic phosphate compound, or organic phosphorus compound; solid or dry	B
*Organic phosphate mixture, organic phosphate compound mixture, or organic phosphorus compound mixture, liquid	B
*Organic phosphate mixture, organic phosphate compound mixture, or organic phosphorus compound mixture, solid or dry	B
ORM-A-n.o.s.	ORM-A
Parathion and compressed gas mixture	A
Parathion, liquid	B
*Parathion mixture, dry	B
Parathion mixture, liquid	B
Perchloro-methyl-mercaptan	B
Perfluoro-2-butene	ORM-A
Phencapton	ORM-A
Phenyl-dichloro-arsine	B
Phenylenediamine, meta or para, solid	ORM-A

Phosgene (diphosgene)	A
Phosphine	A
Poisonous liquid, n.o.s. or poison B, liquid, n.o.s.	B
Poisonous liquid or gas, n.o.s.	A
Poisonous solid, n.o.s., or poison B, solid, n.o.s.	B
Potassium arsenate, solid	B
Potassium arsenite, solid	B
Potassium cyanide, solid	B
*Potassium cyanide solution	B
Potassium dichromate	ORM-A
Silver cyanide	B
Sodium arsenate	B
*Sodium arsenite (solution) liquid	B
Sodium azide	B
Sodim cyanide, solid	B
*Sodium cyanide, solution	B
Sodium dichromate	ORM-A
Sodium pentachlorophenate	ORM-A
Strontium arsenite, solid	B
*Strychnine salt, solid	B
Strychnine, solid	B
Tetrachloroethane	ORM-A
Tetrachloroethylene or perchloroehtylene	ORM-A
Tetraethyl dithio pyrophosphate and compressed gas mixtue	A
Tetraethyl dithio pyrophosphate, liquid	B
Tetraethyl dithio pyrophosphate, mixture, dry	B
Tetraethyl dithio pyrophosphate, mixture liquid	B
Tetraethyl lead, liquid (including flash point for export shipment by water)	B
Tetraethyl pyrophosphate and compressed gas mixture	A
Tetraethyl pyrophosphate, liquid	B
Tetraethyl pyrophosphate, mixture, dry	B
Tetraethyl pyrophosphate, mixture, liquid	B
Tetramethyl methylene diamine	ORM-A
*Thallium salt, solid n.o.s.	B
Thallium sulfate, solid	B
Thiophosgene	B
Thiram	ORM-A
Toluenediamine	ORM-A
Toluene diisocyanate	B
Trichloroethylene	ORM-A
Zinc arsenate	B
Zinc arsenite	B
Zinc cyanide	B

APPENDIX VIII

AUTOCLAVE SPECIFICATIONS

(i) Infectious waste from departments of health care facilities as defined in 250.12(c)(1) may be rendered nonhazardous by subjecting these wastes to the following autoclave temperatures and dwell times:

Steam Autoclave

(1) Laundry: 250 F (121 C) for 30 minutes with 15 minutes prevacuum of 27 in. Hg.

(2) Trash: 250 F (121 C) for 1 hour with 15 minutes prevacuum of 27 in. Hg.

(3) Glassware: 250 F (121 C) for 1 hour with 15 minutes prevacuum of 27 in. Hg. for filled NIH Glassware can.

(4) Liquids: 250 F (121 C) for 1 hour for each gallon.

(5) Animals: 250 F (121 C) for 8 hours with 15 minutes prevacuum of 27 in. Hg.

(6) Bedding: 250 F (121 C) for 8 hours with 15 minutes prevacuum of 27 in. Hg.

APPENDIX IX

CDC CLASSIFICATION OF ETIOLOGIC AGENTS

(i) The CDC Classification of Etiologic Agents on the Basis of Hazard includes the following classes of agents which are of potential hazard:

Class 2

Agents of ordinary potential hazard. This class includes agents which may produce disease of varying degrees of severity from accidental inoculation or injection or other means of cutaneous penetration but which are contained by ordinary laboratory techniques.

Class 3

Agents involving special hazard or agents derived from outside the United States which require a Federal permit for importation unless they are specified for higher classification. This class includes pathogens which require special conditions for containment.

Class 4

Agents that require the most stringent conditions for their containment because they are extremely hazardous to laboratory personnel or may cause serious epidemic disease. This class includes Class 3 agents from outside the United States when they are employed in entomological experiments or when other entomological experiments are conducted in the same laboratory area.

Class 5

Foreign animal pathogens that are excluded from the United States by law or whose entry is restricted by USDA administrative policy.

These agents are specified as follows:

A. Classification of Bacterial Agents

--all species except A. mallei which is in class 3

Arizona hinshawii--all serotypes
Bacillus anthracis
Bordetella--all species
Borrelia recurrentis, B. vincenti
Clostridium botulinum, Cl. chauvoei, Cl. haemolyticum, Cl. histolyticum, Cl. novyi, Cl. septicum, Cl. tetani
Corynebacterium diptheriae, C. equi, C. renale
Diplococcus (streptococcus) pheumoniae
Erysipelothrix insidiosa
Escherichia coli--all enteropathogenic serotypes
Haemophilus ducreyi, H. influenzae
Herellea vaginicola
Klebsiella--al species and all serotypes
Listeria--all species
Mima polymorpha
Moraxella--all species
Mycobacteria--all species except those listed in Class 3
Mycoplasma--all species except Mycoplasma myocoides and mycoplasma agalactiae, which are in class 5
Neisseria gonorrhoeae, N. meningitidis
Pasteurella--all species except those listed in Class 3
Salmonella--all species and all serotypes
Shigella--all species and all serotypes
Sphacrophorus necrophorus
Staphylococcus aureus
Streptobacillus moniliformis
Streptococcus pyogenes
Treponema carateum, T. pallidum, and T. pertenue
Vibrio fetus, V. comma, including biotype El Tor, and V. parahemolyticus

Class 3

Actinobacillus mallei
Bartonella--all species
Brucella--all species
Francisella tularensis
Mycobacterium avium, M. bovis, M. tubercolosis

Pasteurella multocida type B ("buffalo" and other foreign virulent strains)
Pseudomonas pseudomallei
Yersenia pestis

B. Classification of Fungal Agents

Class 2

Actinomycetes (including Nocardia species and Actinomyces species and Arachnia propionica
Blastomyces dermatitides
Cryptococcus neoformans
Paracoccidioides brasiliensis

Class 3

Coccidioides immitis
Histoplasma capsulatum
Histoplasma capsulatum var. duboisii

C. Classification of Parasitic Agents

Class 2

Endamoeba histolytica
Leishmania sp.
Naegleria gruberi
Toxoplasma gondii
Toxocara canis
Trichinella spiralis
Trypanosoma cruzi

Class 3

Schistosoma masoni

D. Classification of Viral, Rickettsial, and Chlamydial Agents

Class 2

Adenoviruses--human--all types
Cache Valley virus
Coxsackie A and B Viruses
Cytomegaloviruses
Encephalomyocarditis virus (EMC)
Flanders Virus

Hart Park Virus
Hepatitus-associated antigen material
Herpes Viruses--except Herpesvirus simiae (Monkey B virus) which is in class 4
Corona viruses
Influenza viruses--all types except A/PR8/34, which is in class 1
Langat virus
Lymphogranuloma venereum agent
Measles virus
Mumps virus
Parainfluenza viruses--all types except Parainfluenza virus 3, SF4 strain, which is in Class 1
Polioviruses--all types, wild and attenuated
Poxviruses--all types except Alastrium, smallpox, Monkey pox, and whitepox, which depending on experiments, are in Class 3 or Class 4.
Rabies virus--all strains except Rabies street virus, which should be classified in Class 3 when inoculated into carnivores
Reoviruses--all types
Respiratory syncytial virus
Rhinoviruses--all types
Rubella virus
Simiar viruses--all types except Herpesvirus simiar (Monkey B virus) and Marburg virus, which are in Class 4
Sindbis virus
Tensaw virus
Turlock virus
Vaccinia virus
Varicella virus
Vole rickettsia
Yellow fever virus, 17D vaccine strain

Class 3

Alastrun, Smallpox, Monkey pox, and Whitepox, when used in vitro
Arboviruses--all strains except those in Class 2 and 4 (Arboviruses indigenous to the United States are in Class 3, except those listed in Class 2. West Nile and Semliki Forest viruses may be be classified up or down, depending on the conditions or use and geographical location of the laboratory.)

Dengue virus, when used for transmission or animal inoculation experiments
Lymphocytic chorimeningitis virus (LCM)
Psittacosis-Ornithosis-Trachoma group of agents
Rabies street virus, when used in inoculations of carnivores (see Class 2)
Rickettsia--all species except *Vole rickettsia* when used for transmission or animal inoculation experiments
Vesicular stomatitis virus
Yellow fever virus--wild, when used *in vitro*

Class 4

Alastrun, *Smallpox*, *Monkey pox*, and *Whitepox*, when used for transmission or animal inoculation experiments
Hemorrhagic fever agents, including *Crimean hemorrhagic fever* (*Congo*), *Junin*, and *Machupo viruses*, and others as yet undefined
Herpesvirus simiae (Monkey B virus)
Lassa virus
Marburg virus
Tick-borne encephalitis virus complex, including *Russian spring-summer encephalitis*, *Kyasanur forest disease*. *Omsk hemorrhagic fever*, and *Central European encephalitis viruses*
Venezuelan equine encephalitis virus, epidemic strains, when used for transmission or animal inoculation experiments
Yellow fever virus--wild, when used for transmission or animal inoculation experiments

Class 5

A. Animal agents excluded from the United States by law. Virus

foot and mouth disease.

B. Animal agents excluded by USDA administrative policy.

African horse sickness virus
African swine fever virus
Besnoitia besnoiti
Borna disease virus
Bovine infectuous petechial fever
Camel pox virus

Ephemeral fever virus
Fowl plague virus
Goat pox virus
Hog cholera virus
Louping ill virus
Lumpy skin disease virus
Nairobi sheep disease virus
Newcastle disease virus (Asiatic strains)
Mycoplasm mycoides (contagious bovine pleuro-pneumonia
Mycoplasm agalactiae (contagious agalactia of sheep)
Rickettsia ruminatium (heart water)
Rift valley fever virus
Sheep pox virus
Swine vesicular disease virus
Teschen disease virus
Trypanosoma vivax (Nagana)
Theileria parva (East Coast fever)
Theileria annulata
Theileria lawrencei
Theileria bovis
Theileria hirci
Vesicular exanthema virus
Wesselsbron disease virus
Zyonema farciminosum (pseudofarcy)

APPENDIX X

RADIOACTIVE WASTE MEASUREMENTS

Radium-226 concentration can be determined by either of the following methods referenced in Part 300 of Standard Methods for the Examination of Water and Wastewater, 13th ed. APHA, AWWA, WPCF, New York (1970).

1. Precipitation method
2. Radon Emanation Technique

Radium-226 concentration in liquid sources can be determined by the method referenced in Interim Radioachemical Methodology for Drinking Water (EPA-600/4-75-008 [Revised]).

Additional Information Concerning Sample Preparation

1. Radioassay Procedures for Environmental Samples U.S. Department of Health, Education and Welfare, Public Health Service, Rockville, Maryland (1967).
2. Method for Determination of Radium-226 in Solid Waste Samples available from USEPA Office of Solid Waste.

APPENDIX XI

(A) DETECTION OF GENE MUTATIONS

(a) Point Mutations in Bacteria

(1) Positive Controls - All assays must be run with a concurrent positive control. Positive control compounds or mixtures shall be selected to demonstrate both the sensitivity of the indicator organism and the functioning of the metabolic activation system.

(2) Negative Controls - A solvent negative control shall be included.

(3) Choice of Organisms - The bacteria used shall include strains capable of detecting base pair substitutions (both transitions and transversions) and frame-shift mutations. The known spectrum of chemical mutagens capable of being detected by the strains shall be considered when selecting the strains. The strains shall also be highly sensitive to a wide range of chemical mutagens. They may include strains whose cell wall, DNA repair, or other capabilities have been altered to increase sensitivity (Ames, 1975; McCann et al., 1975). Although sensitive bacterial assays for forward mutations at specific loci or over some portion of the entire genome may also be appropriate, at the present time the most sensitive and best-characterized bacteria for mutagenicity testing are those capable of indicating reverse mutations at specific loci.

(4) Methodology

(i) General - The test shall be performed in all respects in a manner known to give positive results for a wide range of chemical mutagens at low concentrations. Tests must be run with and without metabolic activation. The sensitivity and reproducibility of the metabolic activation systems and strains used shall be evaluated both by reference to past work with the method and by the concurrent use of positive controls.

(ii) Plate Assays. In general, the EP extract should be tested by plate incorporation assays at various concentrations. Test conditions should minimize the possible effects due to extraneous nutrients, contamination by other bacteria, and high levels of spontaneous mutants.

(iii) Liquid Suspension Assays. A few chemicals (e.g., diethylnitrosamine and demethylnitrosamine) will give positive results only in tests in which the test substance, the bacteria, and the metabolic activation system are incubated together in liquid prior to plating, but not in a plate incorporation assay (Bartsch et al., 1976). Thus, tests shall be conducted in liquid suspension as well as on agar plates.

(iv) Doses. The highest test dose which does not result in excessive cell death shall be used.

(B) DETECTION OF GENE MUTATIONS

(a) Mammalian Somatic Cells In Culture

(1) Choice of Cell Systems - A number of tests in mammalian somatic cells in culture are available in which specific locus effects may be detected in response to chemical exposure (Shapiro et al., 1972; Chu, 1971). The cell line used shall have demonstrated sensitivity of chemical induction of specific-locus mutations by a variety of chemicals. The line shall be chosen for ease of cultivation, freedom from biological contaminants such as mycoplasms, high and reproducible cloning efficiencies, definition of genetic detection, loci, and relative karyotypic stability. The inherent capabilities of the test cells for metabolic activation of promutagens to active mutagens shall also be considered, as well as the use of metabolic activation systems similar to those used with microorganisms.

2. Methodology

(i) General. The test shall be performed in all respects in a manner known to give positive results for a wide range of chemical mutagens. The sensitivity of the system, metabolic activation capability, and its reproducibility must be evaluated by reference to past work and by the concurrent use of positive controls. Culture conditions which may affect the detection of mutations and give falsely high or low figures for reasons other than chemical induction shall be avoided. Definition of detected genetic loci studies and verification that the observed phenotypic changes are indeed genetic alterations should be presented.

(b) Mutation In Fungi

(1) Controls - All considerations discussed under section (A)(a) are applicable.

(2) Choice of Organisms - The fungi used shall include strains capable of detecting base pair substitutions (both transitions and transversions) and frame-shift mutations. More inclusive assay systems, such as those designed to detect recessive lethals, are also acceptable. The known spectrum of chemical mutagens capable of being detected by the strains shall be considered when selecting the strains. The strains shall also be highly sensitive to a wide range of chemical mutagens. Strains altered in DNA repair or other capabilities with the intent to increase sensitivity may be used, subsequent to validation. Either forward or reverse mutation assays may be applied.

(3) Methodology

(i) General - All considerations discussed under Section (A)(a)(4)(i) are applicable. Care should be taken to investigate stage sensitivity, i.e., replicating versus nonreplicating cells, as well as possible requirement for post-treatment growth.

(ii) Plate Assays - While spot tests and plate incorporation assays are useful for preliminary testing, they shall not be considered conclusive.

(C) DETECTING EFFECTS ON DNA REPAIR OR RECOMBINATION AS AN INDICATION OF GENETIC DAMAGE

(a) DNA Repair in Bacteria

(1) Controls - All considerations discussed under section (A) are applicable.

(2) General

(i) When the DNA of a cell is damaged by a chemical mutagen, the cell will utilize its DNA repair enzymes in an attempt to correct the damage. Cells which have reduced capability of repairing DNA may be more susceptible to the action of chemical mutagens, as detected by increased cell death rates. For suspension tests using DNA repair-deficient bacteria, the positive control should be similar in toxicity to the test mixture.

(ii) The DNA repair test in bacteria determine if the test substance(s) is more toxic to DNA repair-deficient cells than it is to DNA repair-competent cells. Such differential toxicity is taken as an indication that the chemical interacts with the DNA of the exposed cells to produce increased levels of genetic damage.

(3) Choice of Organisms - Two bacterial strains, with no known genetic differences other than DNA repair capability, shall

be used. The strains selected shall be known to be capable of indicating the activity of a wide range of chemical mutagens. The spectrum of chemical mutagens and chemical mixtures capable of being detected by the strains and procedures used shall be reported.

(4) Methodology

(i) Plate Test - The EP extract should be tested by spotting a quantity on an agar plate which has had a lawn of the indicator organisms spread over it. After a suitable incubation period, the zone of inhibition around the spot shall be measured for each strain and compared for the DNA repair-competent and DNA repair-deficient strains. If no discrete zone of inhibition is seen with either strain, then the results of the tests are not meaningful.

(ii) Liquid Suspension Test - The liquid suspension test shall also be performed by comparing the rates at which given concentrations of the test substances will kill each of the two indicator strains when incubated in liquid suspension. Conditions should be adjusted so that significant killing of the DNA repair-competent strain occurs, if this is possible. Methodology is discussed in Kelly and Grindley, 1976.

(iii) Doses - The dose level of test substances used in the plate or suspension test shall be adjusted so that significant toxicity to the DNA repair-competent strain is measured. In the plate test, this means that a zone of inhibition must be visible; in the suspension test, significant loss of cell viability must be measured. This may not be possible if the test substance is not toxic to the bacteria or if, in the plate test, it does not dissolve in and diffuse through the agar. The same dose must be used in exposing the DNA repair-competent and repair-deficient strains.

(b) Unscheduled DNA Synthesis In Human Diploid Cells

(1) General - DNA damage induced by chemical treatment of a cell can be measured as an increase in unscheduled DNA synthesis which is an indication of increased DNA repair. Unrepaired or misrepaired alterations may result in gene mutations or in breaks or exchanges which can lead to deletion and/or duplication of larger gene sequences or to translocations which may affect gene function by position effects (Stitch, 1970; Stoltz et al., 1974).

(2) Methodology

(i) General - Primary or established cell cultures with normal repair function shall be used. Standardized human cell strains from repositories are recommended. Controls should be performed to detect changes in scheduled DNA synthesis at appropriate sections in the experimental design. The media conditions shall be optimal for measuring repair synthesis.

(ii) Dose - At least five dose levels shall be used and the time in the cycle of cynchronour or non-proliferating maximum compound dose shall induce toxicity, and the dosing period with the test substance shall not be less than sixty minutes.

(iii) Sister Chromatid Exchange In Mammalian Cells With and Without Metabolic Activation

(1) Controls - All considerations discussed under section A(a) are applicable.

(2) General - Cytological techniques are available to evaluate the genetic damage induced by chemicals. In the past few years a technique has been developed for identifying sister chromatid exchanges much more simply and efficiently than by the autoradiographic method. The method utilizes the fact that a fluorescent stain Hoechst 33258 binds to thymidine-containing DNA but not, or for less efficiently, to BrdUrd-substituted DNA. This means that the order of fluorescence would be brightest for DNA unreplicated in BrdUrd, intermediate for DNA after one round of replication in BrdUrd, and least for DNA following two rounds of replication in BrdUrd. Thus, a sister chromatid exchange can be seen as a switch of fluorescence pattern at the point of exchange. Parry and Wolff

(1974) combined Hoechst staining with Giemsa staining such that the brightly fluorescing regions stain darkly with Giemsa, and the dully fluorescent regions hardly stain at all.

(3) Choice of Organisms - Chromosomal preparations of human peripheral blood leukocytes or Chinese hamster ovary cells shall be used.

(4) Methodology

(i) General - The test method must be capable of detecting sister chromatid exchanges. Procedures reported by Perry and Wolff (1974) and Moorhead et al. (1960) are recommended. Metabolic activation with rat liver S-9 mix should be incorporated whenever it is appropriate.

(ii) Doses - Test substances shall be tested to the highest dose where toxicity does not interfere with the test procedure.

(d) Mitotic Recombination and/or Gene Conversion in Yeast

(1) Controls - All considerations discussed under section (A) are applicable.

(2) General - One can effectively study the chromosomes of eucaryotic microorgansims by employing classical genetic methodologies which depend upon the behavior and interaction of specific markers spaced judiciously within the genome. These methods have been developed over several

decades and have been applied in recent years to the study of induced genetic damage (Zimmerman, 1971, 1973, 1975; Brusick and Andrews, 1974).

(3) Choice of Oganisms - Diploid strains of yeast that detect mitotic crossing-over and/or mitotic gene conversion shall be used. Additionally, as appropriate strains are developed, monitoring for induced non-disjunction and other effects may be possible. Mitotic crossing-over shall be detected in a strain of organism in which it is possible, by genetic means, to determine with reasonable certainty that reciprocal exchange of genetic information has occurred. Strains employed for genetic testing shall be of proven sensitivity to a wide range of mutagens.

(4) Methodology

(i) General - In general, wastes shall be tested in liquid suspension tests.

APPENDIX XII

(A) BIOACCUMULATION POTENTIAL TEST

(a) General - Reverse-phase liquid chromatography is a separation process in which chemicals are injected onto a column of fine particles coated with an nonpolar (water insoluble) oil and then eluted along the column with a polar solvent such as water or methanol. Recent developments in this field have produced a permanently bonded reverse-phase column in which long-chain hydrocarbon groups are chemically bonded to the column packing material which leads to a more reproducible separation. The chemicals injected are moved along the column by partitioning between the mobile water phase and the stationary hydrocarbon phase. Mixtures of chemicals can be eluted in order of their hydrophobicity, with water soluble chemicals eluted first and the oil soluble chemicals last in proportion to their hydrocarbon/water partition coefficient. Calibration of the instrument using compounds of known octanol/water partition coefficient allows this procedure to be used to determine whether an unknown mixture contains compounds with octanol/water partition coefficients above a designed level.

Specific correlations exist between octanol/water partition coefficients and bioconcentration in fish. This test thus offers a rapid, inexpensive method of identifying those mixtures which contain compounds which pose a potential bioaccumulative hazard.

Compounds with Log P 3.0, but which readily biodegrade would not be expected to persist in the environment long enough for accumulation to occur. Thus, a degradation option has been included in order to exempt these substances from the hazardous waste control system.

(b) Chromatography Conditions - A liquid chromatograph equipped with a high pressure stopflow injector and a 254 nm ultraviolet detector with an 8 ul cell volume and 1 cm path length is employed. The column is a Varian Preparative Micropake C-H (Catalog number 07-000181-00), or its equivalent, consisting of a 250 mm X 8 mm (i.d.) stainless steel filled with 10 micron lichrosorb to which octadecylsilane is permanently bonded.

The column is operated at ambient temperature. The solvent consists of a mixture of water and methanol (15:85, v/v) which is pumped through the column at 2.0 ml/minute.

(c) Retention Volume Calibration - Chemicals are dissolved in a mixture of acetone and cyclohexane (3:1, v/v). For preparing the calibration curve the quantity of individual chemicals in the solution is adjusted to give a chromatographic peak of at least 25 percent of the recorder scale. Acetone produces a large peak at approximately 2.6 minutes.

Six chemicals for which Log P has been reported are used to calibrate the elution time in units of Log P. The calibration mixture is summarized in Table 1 and includes benzene, bromo-benzene, biphenyl, bibenzyl, p,p'-DDE, and 2,4,5,2',5'-pentachlorobiphenyl.

TABLE 1

PARTITION COEFFICIENTS FOR CHEMICALS USED FOR CALIBRATION

	Log P
Acetone	0.55
Benzene	2.13
Bromobenzene	2.99
Biphenyl	3.76
Bibenzyl	4.81
p,p'-DDE	5.69
2,4,5,2',5'-Pentachlorobiphenyl	6.11

(d) Sensitivity Calibration - The mixture is chromatographed and a calibration curve prepared daily to eliminate small differences due to flow rate or temperature and to follow the retencion properties of the column during prolonged use. The calibration is made by plotting Log P vs the logarithm of the absolute retention time (log RT). Figure 1 is an example of such a calibration curve.

(e) Test Procedure

(1) Prepare a calibration curve as described above.

(2) Calculate the geometric mean of the instrumental response to the chemicals listed in Table 1 with the exception of the acetone. This value, expresssed in g/25 percent full scale deflection is designated the Instrumental Response (IS).

(3) Extract X liters of the EP extract to be tested, using dichloromethane, and concentrate the extract to a quantity suitable for injection onto the column. The quantity X is determined by the instrumental sensitivity and is given by the relationship: x in liters = IS in micrograms.

(4) Analyze the extract using the now calibrated chromatograph. A positive response is defined as an instrumental response greater than or equal to 25 percent full scale detector response in the region of Log P greater than or equal to 3.5.

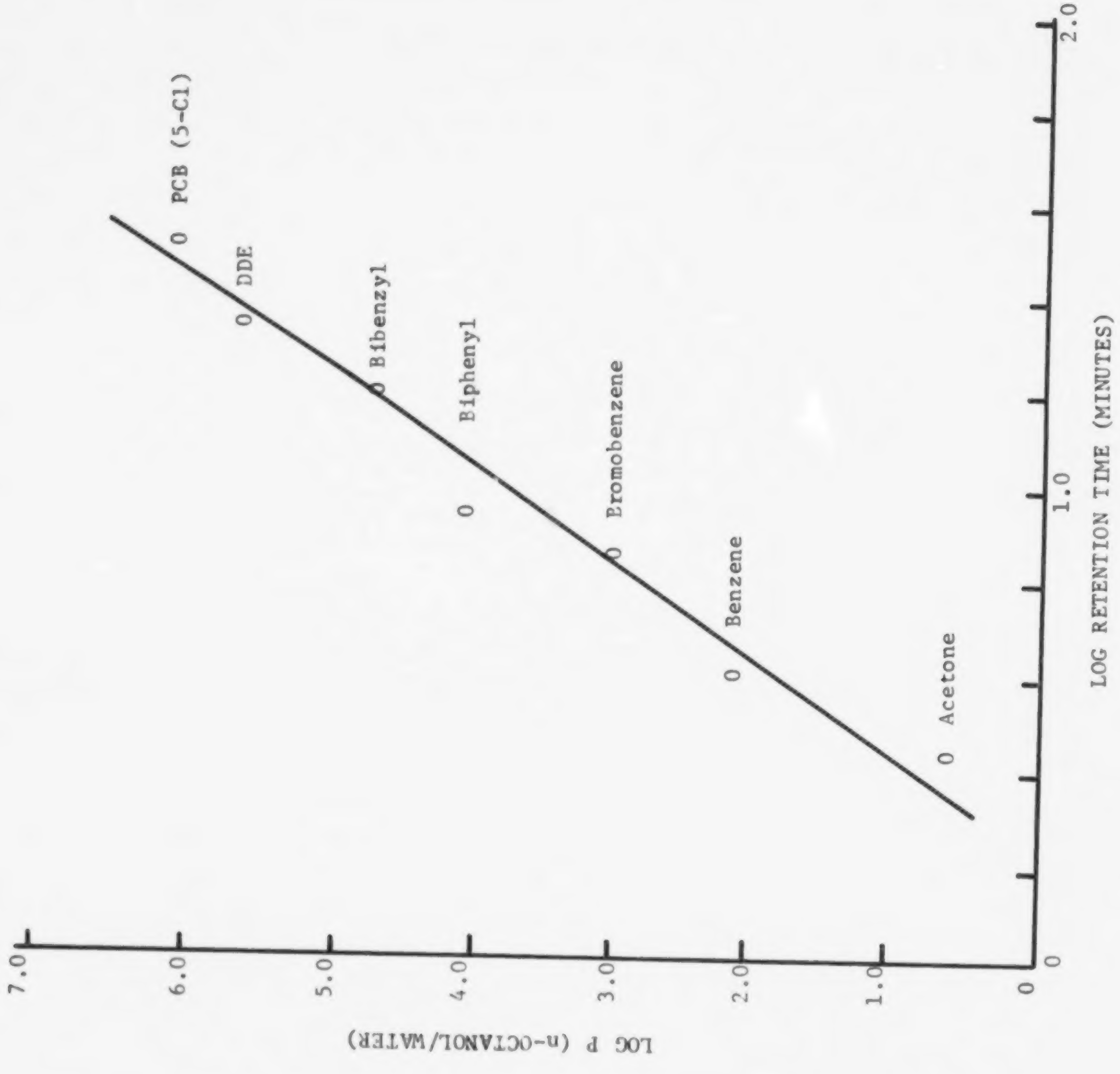
LOG P (n-OCTANOL/WATER)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
0
1.0
2.0
LOG RETENTION TIME (MINUTES)
PCB (5-Cl)
DDE
Bibenzyl
Biphenyl
Bromobenzene
Benzene
Acetone

FIGURE 1

(5) If a positive response is indicated in step D, then subject a sample of the waste to be a standard biodegradation assay and then retest. If a positive response with the degraded waste is not obtained, then the waste is not considered to be hazardous by reason of bioaccumulativeness.

APPENDIX XIII

CONTROLLED SUBSTANCE LIST

Substance	Maximum Permissible TEP Elutriate Concentration (mg/l)
Aloperidin	1
Amantadine	1
4-Aminoantipyrin acetamide	1
Aminopterin	1
3-Amino-1,2,4-triazole	1
6-Azauridine	1
Azo dyes	1
Benzene	1
Bisulfan	1
Carbon tetrachloride	1
Chloroquine	1
Chlorambucil	1
Cobalt salts	1
Colchicine	1
Coumarin derivatives	1
Cyasin	1
Cyclophosphamide	1
Dextroamphetamine sulfate	1
Diazepam (Valium)	1
Diethylstilbesterol	1
Dimethylaminoazobenzene	1
Dimethylnitrosamine	1
Diphenylhydantoin	1
Ethionine	1
Grisefulvin	1
1-Hydroxysafrole	1
Maleic Hydrazide	1
Methotrexate	1
Methylthiouracil	1
Mytomycin-C	1
d-Penicillamine	1
Phenylalanine	1
Phorbol esters	1
Quinine	1
Resperine	1
p-Rosanilin	1
Safrole	1

APPENDIX XIII

CONTROLLED SUBSTANCE LIST (Concluded)

Substance	Maximum Permissible TEP Elutriate Concentration (mg/l)
Serotonin	1
Streptomycin	1
Testosterone	1
Thioacetamide thiourea	1
Trimethadione	1
d-Tubocurarine	1

Appendix XIV

PRIORITY POLLUTANTS

Compound Name

1. acenaphthene
2. acrolein
3. acrylonitrile
4. benzene
5. benzidine
6. carbon tetrachloride (tetrachloromethane)
7. chlorobenzene
8. 1.2,4-trichlorobenzene
9. hexachlorobenzene
10. 1,2-dichloroethane
11. 1,1,1-trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane
17. bis(chloromethyl) ether
18. bis(2-chloroethyl) ether
19. 2-chloroethyl vinyl ether (mixed)
20. 2-chloronaphthalene
21. 2,4,6-trichlorophenol
22. parachlorometa cresol
23. chloroform (trichloromethane)
24. 2-chlorophenol
25. 1,2-dichlorobenzene
26. 1,3-dichlorobenzene
27. 1,4-dichlorobenzene
28. 3,3'-dichlorobenzidine
29. 1,2-dichloroethylene
30. 1,2-trans-dichloroethylene
31. 2,4-dichlorophenol
32. 1,2-dichloropropane
33. 1,2-dichloropropylene (1,3-dichloropropene)
34. 2,4-dimethylphenol
35. 2,4-dinitrotoluene
36. 2,6-dinitrotoluene
37. 1,2-diphenylhydrazine
38. ethylbenzene
39. fluoranthene
40. 4-chlorophenyl phenyl ether
41. 4-bromophenyl phenyl ether

42. bis(2-chloroisopropyl) either
43. bis(2-chloroethoxy) methane
44. methylene chloride (dichloromethane)
45. methyl chloride (chloromethane)
46. methyl bromide (bromomethane)
47. bromoform (tribromomethane)
48. dichlorobromomethane
49. trichlorofluoromethane
50. dichlorodifluoromethane
51. chlorodibromomethane
52. hexachlorobutadiene
53. hexachlorocyclopentadiene
54. isophorone
55. naphthalene
56. nitrobenzene
57. 2-nitrophenol
58. 4-nitrophenol
59. 2,4-dinitrophenol
60. 4,6-dinitro-o-cresol
61. N-nitrodosimethylamine
62. N-nitrosodiphenylamine
63. N-nitrosodi-n-propylamine
64. pentachlorophenol
65. phenol
66. bis(2-ethylhexyl) phthalate
67. butyl benzyl phthalate
68. di-n-butyl phthalate
69. di-n-octyl phthalate
70. diethyl phthalate
71. dimethyl phthalate
72. benzo(a)anthracene (1,2-benzathracene)
73. benzo(a)pyrene (3,4-benzopyrene)
74. 3,4-benzofluoranthene
75. benzo(k)fluoranthane (11,12-benzofluoranthene)
76. chrysene
77. acenaphthylene
78. anthracene
79. benzo(ghi)perylene (1,12-benzoperylene)
80. fluorene
81. phenathrene
82. dibenzo(a,h)anthracene (1,2,5,6-dibenzanthracene)
83. indeno (1,2,3cd)pyrene (2,3-o-phenylenepyrene)
84. pyrene
85. tetrachloroethylene
86. toluene
87. trichloroethylene
88. vinyl chloride (chloroethylene)

89. aldrin
90. dieldrin
91. chlordane (technical mixture & metabolites)
92. 4,4'-DDT
93. 4,4'-DDD (p,p'-DDX)
94. 4,4'-DDD (p,p'-TDE)
95. a-endosulfan-Alpha
96. b-endosulfan-Beta
97. endosulfant sulfate
98. endrin
99. endrin aldehyde
100. heptachlor
101. heptachlor epoxide
102. a-BHC-Alpha
103. b-BHC-Beta
104. r-BHC (lindane)-Gamma
105. g-BHC-Delta
106. PCB-1242 (Arochlor 1242)
107. PCB-1254 (Arochlor 1254)
108. PCB-1221 (Arochlor 1221)
109. PCB-1232 (Arochlor 1232)
110. PCB-1248 (Arochlor 1248)
111. PCB-1260 (Arochlor 1260)
112. PCB-1016 (Arochlor 1016)
113. Toxaphene
114. Antimony (Total
115. Arsenic (Total)
116. Asbestos (Fibrous)
117. Beryllium (Total)
118. Cadmium (Total)
119. Chromium (Total)
120. Copper (Total)
121. Cyanide (Total)
122. Lead (Total)
123. Mercury (Total)
124. Nickel (Total)
125. Selenium (Total)
126. Silver (Total)
127. Thallium (Total)
128. Zinc (Total)
129. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

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Subpart B - Standards Applicable to Generators of Hazardous Waste

250.20	Scope and Purpose
250.21	Definitions
250.22	Manifest
250.23	Reporting
250.24	Recordkeeping
250.25	Containers
250.26	Labeling Practices
250.27	Confidential Information
250.28	Presumption
250.29	Transfer of Liability Contract

250.20 SCOPE AND PURPOSE

(a) These regulations are published pursuant to Sections 2002(a) and 3002 of the Act, which authorize the Administrator to promulgate standards applicable to generators of hazardous waste identified or listed under Subpart A of this Part.

(b) Every generator that designates a hazardous waste for on-site or off-site treatment, storage, or disposal must send it to a permitted facility.

(c) Every generator that designates a hazardous waste for off-site treatment, storage, or disposal at a facility which the generator does not own, need not comply with the reporting requirements of this subpart contained in Sections 250.23(d), (e), (f), (g), and (h).

(d) Every generator that designates a hazardous waste for off-site treatment, storage, or disposal at a facility which the generator owns, need not comply with the requirements of this Subpart contained in Sections 250.23 and 250.24 if the permitted facility is in the same state where hazardous waste generation occurs.

(e) Every generator that designates a hazardous waste for on-site treatment, storage, or disposal, need not comply with the requirements of this Subpart contained in Sections 250.22, 250.23(a), (b), (c), (f), (g), (h), 250.25, and 250.26.

(f) Any generator engaged solely in retail trade or farming, must comply with the requirements of this Subpart only for the treatment, storage and disposal of waste automotive oil.

(g) Any individual who at his or her household generates only household refuse or household septic tank pumpings, is not required to comply with the requirements of this Subpart.

(h) Every generator of waste automotive oil, must designate that waste to a permitted facility.

(i) Any person may assume the generator's total liability for compliance with all the requirements under this Subpart for waste automotive oil only. Any person that assumes the generator's liability must have in writing a Transfer of Liability Contract for each generator, which complies with the requirements of this Subpart contained in Section 250.29.

(j) Any agent who assumes the generator's liability in compliance with Section 250.29 of this Subpart, need not comply with the reporting requirements contained in Sections 250.23(a), (b), (c), (d), and (e).

(k) Every generator must apply to EPA for an identification code before commencing hazardous waste generation activities in accordance with the procedures under Sections 250.822 and 250.823.

(l) Every generator must comply with Subpart D and Subpart E of this part if the waste remains on-site for 90 days or longer.

(m) Any person may designate a hazardous waste for treatment, storage, or disposal at a facility which is not a permitted facility if that facility is not located in an EPA Region or jurisdictions part of the United States.

250.21 DEFINITIONS

For the purpose of this Subpart, all terms not herein defined shall have the meaning given by the Act.

(1) The term "agent" means any person who assumes the generator's liability for the treatment, storage or disposal of waste automotive oil in compliance with the requirements contained in this Subpart.

(2) The term "closing date" means the date which marks the end of a reporting quarter or reporting year.

(3) The term "Delivery Document" means a shipping paper (bill of lading, waybill, dangerous cargo manifest, or other shipping document) used in lieu of the original manifest.

(4) The term "EPA" means the U.S. Environmental Protection Agency.

(5) The term "EPA Region" means the states found in any one of the following ten regions:

  (1) Region 1 - Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island.

  (2) Region II - New York, New Jersey, and Puerto Rico.

  (3) Region III - Pennsylvania, Maryland, West Virginia, and Virginia.

  (4) Region IV - Kentucky, Tennessee, North Carolina, Mississippi, Alabama, Georgia, South Carolina, and Florida.

(5) Region V - Minnesota, Wisconsin, Illinois, Michigan, Indiana, and Ohio.

(6) Region VI - New Mexico, Oklahoma, Arkansas, Louisiana, and Texas.

(7) Region VII - Nebraska, Kansas, Missouri, and Iowa.

(8) Region VIII - Montana, Wyoming, North Dakota, South Dakota, Utah, and Colorado.

(9) Region IX - California, Nevada, Arizona, Hawaii, and Guam.

(10) Region X - Seattle, Oregon, Idaho, and Alaska.

(6) The term "generator" means any person or Federal Agency whose act or process produces hazardous waste (as identified or listed under Subpart A of this part); provided, however, a person or Federal Agency who produces and disposes of no more than 100 kilograms (approximately 220 pounds) per month of hazardous waste (as identified or listed under Subpart A of this part) is not a generator.

(7) The term "identification code" means the unique code assigned by EPA to each generator, transporter, and treatment, storage or disposal facility, pursuant to regulations published in Section 250.20(k) of this Subpart and Subpart G of this part.

(8) The term "international shipment" means the transportation of hazardous waste between an EPA Region and jurisdictions not part of the United States.

(9) The term "interregional shipment" means the transportation of hazardous waste between EPA Regions.

(10) The term "intraregional shipment" means the transportation of hazardous waste within an EPA Region.

(11) The term "manifest document number" means the unique, serially increasing number assigned to the manifest by the generator for recordkeeping and reporting purposes.

(12) The term "on-site" means on the same geographically contiguous property. Two or more pieces of property which are geographically contiguous and are divided by public or private right(s)-of-way are considered a single site.

(13) The term "package" or "outside package" means a packaging plus its contents.

(14) The term "packaging" means the assembly of one or more containers and any other components necessary to assure compliance with the minimum packaging requirements under 49 CFR 173, 178, and 179 and includes containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multiunit tank car tanks.

(15) The term "permitted hazardous waste management facility (or permitted facility)" means a hazardous waste treatment, storage, or disposal facility that has received an EPA permit in accordance with the requirements of Subpart E of this part or a permit from an authorized State agency.

(16) The term "Regional Administrator" means one of the Regional Administrators of the United States Environmental Protection Agency.

(17) The term "reporting quarter" means the three month time period covered by each quarterly report; the reporting quarters shall end on the last day of March, June, September, and December.

(18) The term "reporting year" means the twelve month time period covered by each annual report; the reporting year shall end on the last day of September.

(19) The term "spill" means any accidental discharge of a hazardous waste onto or into the land or water.

(20) The term "storage tank" means any manufactured nonportable covered device used for containing pumpable hazardous waste.

250.22 MANIFEST

(a) Every generator must, for each off-site shipment of hazardous waste, ensure that the following information is designated on the manifest (See Table I for a sample manifest format):

(1) A manifest document number;

(2) The generator's (or generators') identification code(s), name(s), address(es), and the date of shipment;

(3) The identification code(s), name(s), and address(es), of the transporter(s);

(4) The identification code(s), name(s), and address(es), of the permitted facility(ies);

(5) The name and code of the hazardous waste (under the column "shipping description"), by its Department of Transportation (DOT) proper shipping name (49 CFR 172), or by the U.S. Environmental Protection Agency (EPA) name (as listed under Section 250.14 of Subpart A of this part), if the DOT proper shipping name is not applicable. However, if the DOT proper shipping name "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name (as listed under Section 250.14 of Subpart A of this part) must also be designated on the manifest after the DOT proper shipping name NOS;

(6) The hazard class of each waste as identified or listed under the DOT hazard class (49 CFR 172), or by the EPA characteristic (as identified or listed under Section 250.13(a) and 250.14 of Subpart A of this part) if the DOT hazard class is not applicable. However, if the DOT hazard class "OTHER REGULATED MATERIALS" (ORM) is used, the EPA characteristic (as identified or listed under Section 250.13(a) and 250.14 of Subpart A of this part) must also be designated on the manifest after the DOT hazard class ORM;

(7) The quantity of each hazardous waste, by units of volume or weight in pounds (P), tons (T), gallons (G), or cubic yards (CY); or by the number of drums (D) with their capacities;

(8) Directions as to what immediate action should be taken regarding a spill, or a 24-hour telephone number or numbers where information on how to handle a spill can be obtained;

(9) The statement "In the event of a spill contact the National Response Center, U.S. Coast Guard, 800-424-8802 for emergency assistance;"

(10) When available, special handling instructions; and

(11) When appropriate, additional comments.

In addition to the above, the generator must:

(i) Make the following certification: "This is to certify that the above-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the U.S. Environmental Protection Agency; and

(ii) Certify the information on the manifest by having an authorized representative of the generator sign and date it.

(b) Every generator must retain at least one copy of the manifest with the generator's and the transporter's signature until a copy of the manifest or delivery document signed by an authorized agent of the treatment, storage, and dispoal facility is received. Every generator must give the transporter at least three copies of the signed manifest before allowing shipment of the hazardous waste.

250.23 REPORTING

Reporting for Off-site Shipments of Hazardous Waste

(a) Generators who designate hazardous waste for off-site treatment, storage, or disposal must:

(1) Make an annual report for intraregional or interregional shipments of hazardous waste based on the information designated on the manifests which were dated for shipment during the reporting year;

(2) Make a quarterly report based on the information designated on the manifest for shipments of hazardous waste sent during the reporting quarter to a treatment, storage, or disposal facility but not received, or for international shipments of hazardous waste. Receipt of a hazardous waste shipment is defined by the return of a signed copy of the manifest or delivery document to the generator by an authorized agent of the treatment, storage, or disposal facility. No quarterly report is required for intraregional or interregional shipments of hazardous wastes if all hazardous waste shipments are received by the treatment, storage, or disposal facility.

(3) Send the report within four weeks after the closing date to the Regional EPA Administrator with regulatory authority over the generator.

(b) Generators who treat, store, or dispose of hazardous waste off-site must designate in the annual report (see Table II for the report form):

(1) The generator's identification code, name, and address;

(2) The closing date of the annual reporting period;

(3) The identification code of each permitted facility to which a hazardous waste has been sent;

(4) The name and code of each hazardous waste appearing on the manifest under "shipping description" which was treated, stored, or disposed of at a permitted facility;

(5) The total quantity of each hazardous waste;

(6) The units of volume or weight of each quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY).

In addition to the above, the generator must:

(i) Make the following certification: "I certify that the above information is correct to the best of my knowledge and belief;" and

(ii) Certify the information on the report by having an authorized representative of the generator sign and date it.

(c) Generators who treat, store, or dispose of hazardous waste off-site must designate in the quarterly report for hazardous waste shipment(s) not received by a treatment, storage, or disposal facility or for international shipment(s) of hazardous waste (See Table II for the report form):

(1) The generator's identification code, name, and address;

(2) The closing date of the quarterly reporting period;

(3) The letters "NR" for hazardous waste shipments not received at a treatment, storage, or disposal facility, or the letter "I" if the shipment was international. Followed by the identification code of the permitted facility(ies) or for international shipments the name and address of the treatment, storage, or disposal facility(ies) to which a hazardous waste has been sent;

(4) The manifest document number, followed by the date of shipment to the treatment, storage, or disposal facility;

(5) The name and code of each hazardous waste appearing on the manifest under "shipping description;"

(6) The total quantity of each hazardous waste; and

(7) The units of volume or weight of each quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY).

In addition to the above, the generator must:

(i) Make the following certification: "I certify that the above information is correct to the best of my knowledge and belief;" and

(ii) Certify the information on the report by having an authorized representative of the generator sign and date it.

Reporting for On-site Treatment, Storage, and Disposal of Hazardous Waste

(d) Generators who designate hazardous waste for on-site treatment, storage, or disposal must make an annual report and send the report within four weeks after the closing date to the Regional EPA Administrator with regulatory authority over it.

(e) Generators who treat, store, or dispose of hazardous waste on-site must designate in the annual report:

(1) The generator's identification code, name, and address;

(2) The closing date of the annual reporting period;

(3) The word "on-site" under column three ("treatment, storage or disposal facility I.D. Code"),

(4) The name and code of the hazardous waste (under "shipping description"), by its Department of Transportation (DOT) proper shipping name (49 CFR 172), or

by the U.S. Environmental Protection Agency (EPA) name (as listed under Section 250.14 of subpart A of this part) if the DOT proper shipping name is not applicable. However, if the DOT proper shipping name "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name (as listed under Section 250.14 Subpart A of this part) must also be designated on the report after the DOT proper shipping name NOS;

(5) The hazard class of each waste as identified or listed under the DOT hazard class (49 CFR 172), or by the EPA characteristic (as identified or listed under Section 250.13(a) and 250.14 of Subpart A of this part) must also be designated on the report after the DOT hazard class ORM; and

(6) The total quantity of each hazardous waste; and

(7) The units of volume or weight of each quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY).

In addition to the above, the generator must:

(i) Make the following certification: "I certify that the above information is correct to the best of my knowledge and belief;" and

(ii) Certify the information on the report by having an authorized representative of the generator sign and date it.

Reporting for Agents of Waste Automotive Oil Generators

(f) Any agent who assumes the generator's liability for waste automotive oil must:

(1) Make an annual report for intraregional or interregional shipments of hazardous waste based on the information designated on the manifests which were dated for shipment during the reporting year;

(2) Make a quarterly report based on the information designated on the manifest for shipments of such hazardous waste sent during the reporting quarter to a treatment, storage, or disposal facility but not received, or for international shipment of hazardous waste. Receipt of a hazardous waste shipment is defined by the return of a signed copy of the manifest or delivery document to the generator by an authorized agent of the treatment, storage, or disposal facility. No quarterly report is required for intraregional or interregional shipments of hazardous waste if all hazardous waste shipments are received by the treatment, storage, or disposal facility.

(3) Send the report within four weeks after the closing date to the Regional EPA Administrator with regulatory authority over the person.

(g) Any agent who assumes the generator's liability for waste automotive oil must designate in the annual report:

(1) The agent's identification code (if applicable), name, and address;

(2) The closing date of the annual reporting period;

(3) The identification code of each hazardous waste treatment, storage, or disposal facility to which waste automotive oil has been sent;

(4) The identification code of each generator whose liability was assumed during the reporting year under the column labeled "manifest document number;"

(5) The name "waste automotive oil" under the column "shipping description;"

(6) The total quantity of waste automotive oil received at a permitted facility;

(7) The units of volume or weight of the total quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY) received at each permitted facility.

In addition to the above, the person must:

(i) Make the following certification: "I certify that the above information is correct to the best of my knowledge and belief;" and

(ii) Certify the information on the report by having an authorized representative of the person sign and date it.

(h) Any agent who assumes the generator's liability for waste automotive oil must designate in the quarterly report for hazardous waste shipment(s) not received by a treatment, storage, or disposal facility, or for international shipment(s) of hazardous waste (See Table II for the report form):

(1) The agent's identification code (if applicable), name, and address;

(2) The closing date of the quarterly reporting period;

(3) The letters "NR" for hazardous waste shipments not received at a treatment, storage, or disposal facility or the letter "I" if the shipment was international. Followed by the identification code of the permitted facility(ies) or for international shipments the name and address of the treatment, storage, or disposal facility(ies) to which a waste automotive oil has been sent;

(4) The manifest document number, followed by the date of shipment to the hazardous waste treatment, storage, or disposal facility;

(5) The name "waste automotive oil" under the column "shipping description;"

(6) The total quantity of waste automotive oil; and

(7) The units of volume or weight of the total quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY).

In addition to the above, the person must:

(i) Make the following certification: "I certify that the above information is correct to the best of my knowledge and belief;" and

(ii) Certify the information on the report by having an authorized representative of the person sign and date it.

250.24 RECORDKEEPING

Every generator must keep a copy of each manifest signed by an authorized agent of the treatment, storage, or disposal facility for three years from date of shipment.

250.25 CONTAINERS

(a) Every generator must place the hazardous waste:

(1) In a package in accordance with the Department of Transportation regulations on packing under 49 CFR 173, 178, and 179. If no specific packaging is required, the generator must place the hazardous waste in a package in accordance with the Department of Transportation regulations on standard requirements for all packages 49 CFR 173.24(a), (b), and (c) (2)-(9); or

(2) In a permanent storage tank that complies with the mandatory requirements of Section 250.44-1 of Subpart D of this part.

250.26 LABELING PRACTICES

(a) Every generator must label and placard each shipment of hazardous waste in accordance with the Department of Transportation regulations on hazardous materials, 49 CFR 172.

(b) Every generator must mark each package of hazardous waste in accordance with the Department of Transportation regulations on marking, 49 CFR 172.300. If no Department of Transportation proper shipping name is applicable to a particular waste, then the appropriate EPA name (as listed under Section 250.14 of subpart A of this part) should be used to mark the package. However, if the DOT proper shipping name "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name (as listed under section 250.14 of Subpart A of this part) must also be designated as part of the marking after the DOT proper shipping name NOS.

(c) Every generator must mark each package of hazardous waste using the following words:

CONTROLLED WASTE-Federal Law prohibits Improper Disposal.

Generator I.D. Code ______________________________.

Manifest Document Number __________________________.

The generator's identification code and the manifest document number(s) must appear in the space following the words "Generator I.D. Code" and "Manifest Document Number," respectively.

The marking must use the same color(s), approximate dimension(s), and material(s) needed to make markings required by Section 250.26(b) of this Subpart.

250.27 CONFIDENTIAL INFORMATION

All information provided in connection with the manifest and reporting system established by the Subpart shall be available to any person to the extent and in the manner authorized by Section 3007(b) of the Act, the Freedom of Information Act (5 U.S.C. Section 552), and the EPA Regulations adopted in compliance with that Act (40 CFR Part 2). Generators who wish to apply to the Administrator of EPA to keep certain items confidential must mark those items, as they appear on the manifest or report: "CONFIDENTIAL." If a request is made, the provisions of 40 CFR Part 2 shall apply.

250.28 PRESUMPTION

In all civil enforcement proceedings brought under the Act, there shall be a rebuttable presumption that defendant's act or process produces and disposes of more than 100 kilograms in any one month of hazardous waste (as identified or listed under Subpart A of this Part).

250. 29 TRANSFER OF LIABILITY CONTRACT

(a) Each generator entering into a Transfer of Liability Contract and every person assuming the generator's liabilities for compliance with requirements contained in this Subpart must keep a signed copy of the Transfer of Liability Contract as a permanent record during the time the contract is in effect and for a period of one year following its termination.

(b) The Transfer of Liability Contract must state in writing the following:

"THIS TRANSFER OF LIABILITY CONTRACT, made this ______________ day of ______________, 19___, between name of generator hereinafter called the Generator, and name of person assuming the generator's liability hereinafter called the Agent:

WITNESSETH: That the Generator transfers to the Agent and the Agent transfers from the Generator for a term of ______________ months and ______________ days beginning on the ______________ day of ______________, 19___ , the total liability for compliance with all the requirements contained in 40 CFR 250.20 - 250.29 for the Generator's waste automotive oil.

Generator ____________________________________ (SEAL)

Agent ____ (SEAL)

(c) The Transfer of Liability Contract must be complete and signed by an authorized representative of the generator and the person assuming the generator's liability for compliance with the requirements contained in this Subpart.

TABLE I

HAZARDOUS WASTE MANIFEST

MANIFEST DOCUMENT NUMBER

IDENTIFICATION

	I.D. CODE	NAME	ADDRESS	DATE SHIPPED OR RECEIVED
GENERATOR				
TRANSPORTER				
TSDF (TREATMENT, STORAGE OR DISPOSAL FACILITY)				

WASTE INFORMATION

SHIPPING DESCRIPTION	HAZARD CLASS	QUANTITY	*(Complete Applicable Column)*	
			UNIT	CONTAINER TYP

EMERGENCY INFORMATION

IMMEDIATE RESPONSE INFORMATION

PHONE NUMBER

SPECIAL HANDLING INSTRUCTIONS

COMMENTS

CERTIFICATION

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the U.S. Environmental Protection Agency.

GENERATOR SIGNATURE ______________________ DATE ____________

This is to certify acceptance of the hazardous waste shipment.

TRANSPORTER SIGNATURE ______________________ DATE ____________

This is to certify acceptance of the hazardous waste for treatment, storage, or disposal.

TSDF SIGNATURE ______________________ DATE ____________

TABLE II

HAZARDOUS WASTE GENERATOR REPORT

IDENTIFICATION

NAME

ADDRESS

GENERATOR IDENTIFICATION CODE

CLOSING DATE

WASTE INFORMATION

TREATMENT, STORAGE OR DISPOSAL FACILITY I.D. CODE	MANIFEST DOCUMENT NUMBER	SHIPPING DESCRIPTION	QUANTITY	UNIT OF MEASURE

COMMENTS

CERTIFICATION

I certify that the above information is correct to the best of my knowledge and belief.

SIGNATURE

DATE

SUBPART C - STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTES

250.30 Scope

250.31 Definitions

250.32 Identification Code

250.33 Recordkeeping

250.34 Acceptance and Transport of Hazardous Waste

250.35 Compliance with the Manifest

250.36 Delivery of Hazardous Wastes to a Designated Permitted Facility

250.37 Spills

250.38 Placarding/Marking of Vehicles

250.30 SCOPE

(a) These regulations establish standards which apply to any person or Federal agency that transports hazardous waste within the United States which requires a manifest as specified under Subpart B of this part or any transporter importing a shipment of hazardous waste from abroad. If a manifest is not required, any person or Federal agency that consolidates for shipment and transports hazardous waste shall deliver the entire quantity of hazardous waste(s) to a facility permitted under Subpart E of this part and shall comply with the DOT regulations listed in 250.30(c).

(b) These regulations do not apply to persons or Federal agencies that transport hazardous waste(s) on the site of a hazardous waste generator or permitted hazardous waste management facility.

(c) If hazardous waste identified or listed under Subpart A of this part also meets the definition and criteria for hazardous materials of the Department of Transportation (49 CFR 171.8 and 173), the following regulations of the Department of Transportation will apply for both intrastate and interstate transportation: 49 CFR 171, General Information, Regulations and Definitions; 49 CFR 174, Carriage by Rail; 49 CFR 175, Carriage by Public Highway; 46 CFR 30-40 Tank Vessels; 46 CFR 64 Marine Portable Tanks; 46 CFR 98, Bulk Cargos; 46 CFR 148, Solids in Bulk; and 46 CFR 98, Bulk Cargos; 46 CFR 148, Solids in Bulk; and 46 CFR 151, Unmanned Barges.

250.31 DEFINITIONS

For purposes of this part, all terms not herein defined shall take the meaning given them by the Solid Waste Disposal Act (Pub. L. 94-580).

(a) "Delivery document" means a shipping paper (bill of lading, waybill, dangerous cargo manifest, or other shipping document) used in lieu of the original manifest to fulfill the recordkeeping requirement of 250.33.

(b) "Generator" means any person defined as a generator in regulations under Subpart B of this part.

(c) "Hazardous material" means a substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated under 49 CFR 171.8 and 173.

(d) "Identification code" means the unique code assigned to each transporter of hazardous waste by EPA or an authorized State upon notification in accordance with Subpart G of this part or upon compliance with 250.32 of this Subpart.

(e) "Manifest" means the form used for identifying the quantity, composition, and the origin, routing and destination of hazardous waste as specified in regulations under 250.22 Subpart B of this part.

(f) "Mode" means any of the following transportation methods: rail, highway, air, or water.

(g) "Motor vehicle" means a vehicle, machine, tractor, trailer or semitrailer, or any combination thereof, propelled or drawn by mechanical power and used upon the highways in transportation. It does not include a vehicle, locomotive, or car operated exclusively on a rail or rails.

(h) "On the site" means on the same or geographically contiguous property. Two or more pieces of property which are geographically contiguous and are divided only by public or private right(s)-of-way are considered a single site.

(i) "Permitted hazardous waste management facility" (or "permitted facility") means a hazardous waste treatment, storage, or disposal facility that has received an EPA permit in accordance with the requirements of Subpart E of this part or a permit from an authorized State agency.

(j) "Spill" means any accidental discharge of a hazardous waste onto or into the land or water.

(k) "Transporter" means a person or Federal agency engaged in the transportation of hazardous waste by air, rail, highway, or water.

(l) "Transport vehicle" means a motor vehicle, rail freight car, freight container, cargo tank, portable tank, or vessel (as defined in 49 CFR 171.8) used for the transportation of hazardous waste.

(m) "United States" means the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

250.32 IDENTIFICATION CODE

Any transporter who transports or intends to transport hazardous waste within the United States shall comply with 250.822 and 250.823 to obtain an identification code from the Environmental Protection Agency or an authorized State. The identification code issued shall be included on:

(1) The manifest (Section 250.22);
(2) The Hazardous Materials Incident Report (Section 250.37); and
(3) The delivery document (Section 250.35 (c)).

250.33 RECORDKEEPING

Each transporter shall maintain a copy of the manifest or delivery document for a period of not less than three years from date of either transfer of the hazardous waste to another transporter or delivery of the hazardous waste to a permitted facility as indicated on the manifest or the delivery document.

250.34 ACCEPTANCE AND TRANSPORT OF HAZARDOUS WASTE

(a) A transporter shall not accept from a generator a shipment of hazardous waste without a manifest signed by the generator in accordance with the provisions of 250.22.

(b) A transporter shall not transport a shipment of hazardous waste from a generator without signing the manifest acknowledging acceptance of the hazardous waste shipment.

(c) If a shipment of hazardous waste is transported by more than one transporter, subsequent transporters shall not accept for transport or transport the hazardous waste shipment without a manifest or shipping document that contains the information on the manifest in accordance with the provisions of 250.22.

(d) A transporter shall not transport a shipment of hazardous waste in containers not properly labeled or marked in accordance with the provisions of 250.26.

(1) If the DOT label is lost or detached, the transporter must replace that DOT label in accordance with the provisions of 250.26.

(2) The DOT replacement label must be based on the information taken from the manifest covering the shipment.

(e) A transporter shall not transport containers which are leaking or appear to be damaged. In the event that leakage develops or is discovered during transportation and the leakage results in a spill, the transporter shall comply with 250.37.

(f) A transporter shall not accept or consolidate hazardous waste(s) consisting of a material or mixture of materials that is prohibited from transportation by 49 CFR 173.21.

250.35 COMPLIANCE WITH THE MANIFEST

(a) Each transporter shall assure that a copy of the manifest or the information contained on the manifest (in the form of, e.g., a hazardous materials shipping paper, bill of lading, waybill) at all times accompanies the shipment of hazardous waste.

(b) If the hazardous waste shipment is transferred between the different modes (air, rail, highway, or water) or between different transporters using the air or highway mode, each transporter and each subsequent transporter shall sign the manifest or delivery document acknowledging acceptance of the shipment before the hazardous waste can be transported.

(c) The delivery document shall:

- (1) Contain as a minimum, the following information:
  - (i) Name, address of transporter;
  - (ii) Name, address, identification code of generator;
  - (iii) Name, address, identification code of designated permitted facility;
  - (iv) Corresponding manifest document number; and
  - (v) Description and quantity of hazardous waste.

(2) Only be used when the original manifest is not with the shipment of hazardous waste.

(d) The transporter shall, upon delivery of the hazardous waste to the designated permitted facility, obtain the signature of an authorized agent of the permitted facility on the manifest or delivery document certifying delivery.

(1) If a delivery document is used in lieu of the manifest, the transporter shall issue three copies of the delivery document to the designated permitted facility for signature. The transporter shall retain one of signed copies as required by 250.33.

(2) If the transporter cannot acquire immediate certification, the transporter shall:

(i) Indicate on the manifest or delivery document the following:

(A) Time and date of delivery; and

(B) Reason manifest or delivery document could not be certified upon delivery; and

(ii) Acquire certification on the manifest or delivery document by an authorized agent of the permitted facility as soon as possible, but not to exceed five working days after delivery of the shipment.

250.36 DELIVERY OF HAZARDOUS WASTES TO A DESIGNATED PERMITTED FACILITY

(a) The transporter shall deliver the entire quantity of hazardous waste(s) accepted from a generator or a transporter to a permitted facility designated by the generator on the manifest.

(b) If the transporter removes the hazardous waste from a transport vehicle or aircraft for purposes of blending, mixing, treating, or storing, it shall be done at a permitted facility.

(c) If hazardous wastes from different generators or separate wastes from the same generator become mixed after having been accepted by the transporter, the transporter shall comply with the generator standards under Subpart B of this part unless the transporter can demonstrate that the information designated on the manifest(s) under Section 250.22 (a) (5), (6) of Subpart B of this part still identifies the hazardous waste.

250.37 SPILLS

(a) If a spill of hazardous waste requires immediate removal to protect human health or the environment (as determined by EPA, other Federal Agencies, or a State or local authorized official), the requirements of this Section shall apply in lieu of Sections 250.32, 250.33, 250.34, 250.35, 250.36, and 250.38 of this Subpart until the spill is cleaned up or until such action is taken so that the spilled hazardous waste no longer presents an immediate hazard to human health or the environment (as determined by EPA, other Federal Agencies, or a State or local authorized official).

(b) In the event of any spill of hazardous waste during transportation, the transporter shall:

- (1) Telephone immediately:
    - (i) The National Response Center, U.S. Coast Guard, toll free, 800-424-8802; or
    - (ii) The government official predesignated in the applicable Regional contingency plan pursuant to 40 CFR 1510 as the on-scene coordinator for the geographic area in which the incident occurs.
- (2) Furnish the following information upon notification:
    - (i) Name of person reporting the spill;
    - (ii) Name and address of transporter;
    - (iii) Name and address of generator;
    - (iv) Phone number where reported can be contacted;
    - (v) Date, time, and location of incident (indicate pollution of land, water, air, or public water supply, if known);
    - (vi) Type of transport vehicle and mode;
    - (vii) Type of incident (e.g., fire, breakage, spillage);
    - (viii) Classification, name, and quantity of hazardous waste involved, to the extent available; and

(ix) The extent of injuries, if any.

(3) File within 15 days a written report in duplicate with the Director, Office of Hazardous Materials Operations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590, on each spill that occurred during the course of transportation. DOT form F 5800.1 (Appendix A) shall be utilized as a basic reporting document; item A 1.6 shall be filled in as "waste;" item B4 shall include the transporter's identification code. In addition under part H of DOT form 5800.1, the following information shall be included:

(i) If known, location of spill in relation to surface waters, public water supply, groundwater, wildlife habitats, and agricultural production areas;

(ii) Quantity of material removed and disposition of the material; and

(iii) Disposition and quantity of unremoved material.

(c) The transporter shall clean up all the spilled hazardous waste or take such action as may be required by Federal, State, or local agencies so that the spilled hazardous waste no longer presents a hazard to human health or the environment.

250.38 PLACARDING/MARKING OF VEHICLES

(a) A transporter shall not move a transport vehicle containing hazardous waste which is also a DOT hazardous material unless it is placarded in accordance with 49 CFR 172, Subpart F. This prohibition applies to both intrastate and interstate transportation.

(b) A transporter shall mark each motor vehicle being operated under its own power for the transportation of hazardous waste if the motor vehicle is required to be placarded or if the motor vehicle contains greater than 1,000 pounds of hazardous waste. The marking shall display the following information:

(1) Name of transporter under whose authority the vehicle is being operated; and

(2) The city or community in which the carrier maintains its principal office or in which the vehicle is customarily based.

(i) The marking must:

(A) Appear on both sides of the vehicle;

(B) Be in letters that contrast sharply in color with the background; and

(C) Be readily legible during daylight hours from a distance of 50 feet while the vehicle is stationary.

(ii) The marking may consist of a removable device meeting the above identification requirements.

SUBPART D - STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITIES

250.40	Scope/Applicability
250.41	Definitions
250.42	Human Health and Environmental Standard
250.42-1	Groundwater Human Health and Environmental Standard
250.42-2	Surface Water Human Health and Environmental Standard
250.42-3	Air Human Health and Environmental Standard
250.42-4	Commercial Products Human Health and Environmental Standard
250.43	General Facility Standards
250.43-1	General Site Selection
250.43-1	Financial Requirements
250.43-3	Security
250.43-4	Emergency Procedures and Contingency Plans
250.43-5	Training
250.43-6	Manifest System, Recordkeeping and Reporting
250.43-7	Visual Inspections
250.43-8	Closure and Post Closure
250.43-9	Groundwater and Leachate Monitoring
250.44	Standards for Storage
250.44-1	Storage Tanks
250.44-2	Containers
250.45	Standards for Treatment/Disposal

250.45-1 Incineration

250.45-2 Landfills

250.45-3 Surface Impoundments

250.45-4 Basins

250.45-5 Landfarms

250.45-6 Chemical, Physical and Biological Treatment Facilities

250.45-7 Facilities Which Make Commercial Products From Hazardous Wastes

250.46 Special Waste Standards

250.46-1 Cement Kiln Dust Wastes

250.46-2 Utility Wastes

250.46-3 Phosphate Rock Mining and Processing Waste

250.46-4 Uranium Mining/Milling Wastes

250.46-5 Other Mining Wastes

250.46-6 Oil Drilling Mud/Brines

Annexes

Annex 1 EPA Interim Primary and Proposed Secondary Drinking Water Standards

Annex 2 Threshold Limit Values for Chemical Substances

Annex 3 TSDF Report

Annex 4 Incompatible Wastes

Annex 5 Methods for Determining Soil pH

250.40 SCOPE/APPLICABILITY

(a) These regulations are published pursuant to Subtitle C of the Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6924, et seq.), and are responsive to the requirements of Section 3004, which directs the Administrator to promulgate regulations establishing standards applicable to owners and operators of facilities for the treatment, storage, and disposal of hazardous waste.

(b) All owners and operators of facilities that store, treat, and/or dispose of hazardous wastes designated pursuant to Subpart A, except those hazardous wastes listed as Special Wastes in Section 250.46, shall comply as follows with the applicable standards of the Subpart:

(1) All owners and operators of such facilities shall comply with the General Facility Standards of Section 250.43.

(2) All owners and operators of such facilities shall comply with the Storage Standards of Section 250.44 with respect to any hazardous waste that is stored.

(3) All owners and operators of such facilities shall comply with the respective Treatment and Disposal Standards of Section 250.45 with respect to any hazardous waste that is treated and/or disposed.

(c) All owners and operators of facilities that store, treat and/or dispose of Special Wastes listed in Section 250.46 shall comply with the General Facility Standards of Section 250.43 and the respective Special Waste Standards of Section 250.46.

(d) Many standards have notes which give the basis for a variance for determining an equivalent standard which provides the same degree of protection of human health and the environment. Any facility which complies with a specific site variance arrived at in accordance with these notes which the Administrator deems to be equivalent shall be considered in compliance with the published standard.

(e) All owners and operators of facilities that store, treat and/or dispose of hazardous waste shall also comply with the Human Health and Environmental Standards of Section 250.42. Where compliance with the Human Health and Environmental Standards requires meeting more stringent requirements than prescribed by the General Facility Standards, the Storage Standards, the Treatment and Disposal Standards or equivalent permit conditions as defined in 250.40(e), the Human Health and Environmental Standards shall take precedence and shall be the basis for permit conditions as and when permits are issued or reissued.

NOTE: The General Facility Standards, Storage Standards, Treatment and Disposal Standards, and Special Waste Standards are designed to achieve compliance with the Human Health and Environmental Standards. Accordingly, compliance with these design and operating standards, or equivalent permit conditions, presumes compliance with the Human Health and Environmental Standards. It is planned and expected that implementation of the hazardous waste program under RCRA (permit issuance and enforcement) will be principally based on the design and operating standards, or equivalent permit conditions. In certain unanticipated situations, however, it is expected, because of atypical geologic, climatic, waste, or other characteristics, that the design and operating standards or equivalent permit conditions will not achieve compliance with the Human Health and Environmental Standards. In these cases, the Human Health and Environmental Standards will take precedence, and will be the basis for design and operating requirements reflected in permit conditions.

(f) All appropriate facilities must comply with the requirements of Subpart E.

(g) Publicly owned treatment works which receive hazardous waste by truck or by rail are exempt from the Subpart D requirements, except the manifest reporting requirements specified in 250.43-6.

250.41 DEFINITIONS

For the purposes of this Part:

(1) "Active Fault" means a fault which, according to geologic evidence, is capable of movement along a fault trace for as long as the hazardous waste at the site may pose a threat to the environment.

(2) "Active Portion" means that portion of a facility where treatment, storage, or disposal operations are being conducted or any part of a facility where hazardous wastes are present. It includes the treated area of a landfarm and the active face of a landfill.

Building roofs and roads are excluded unless designated as "active portions" by the Administrator.

(3) "Administrator" means the Administrator of the Environmental Protection Agency, or his designee.

(4) "Annular Space of a Well" means the space between the bore hole and the casing.

(5) "Aquifer" means a geologic formation, group of formations, or part of a formation that is capable of yielding usable quantities of water to a well or spring.

(6) "Attenuation" means any decrease in the maximum concentration or total quantity of an applied chemical or biological constituent in a fixed time or distance traveled resulting from a physical, chemical, and/or biological reaction or transformation occurring in the zone of aeration or zone of saturation.

(7) "Basin" means any uncovered device constructed of artificial materials, used to retain wastes as part of a treatment process, usually with a capacity of less than 100,000 gallons. Examples of basins include open mixing tanks, clarifiers, and open settling tanks.

(8) "Bore Hole" means a man-made hole in a geological formation which has been drilled, jetted, driven or made by other similar techniques.

(9) "Cell of a Landfill" means a portion of a landfill which is isolated horizontally and vertically, usually by means of an impermeable barrier from other portions.

(10) "Chemical Fixation" means the treatment process involving reactions between various waste materials and certain chemical systems, resulting in solids which encapsulate, immobilize or otherwise tie up hazardous components so as to reduce leachability and render the waste nonhazardous or suitable for disposal.

(11) "Close Out" means the point in time at which facility owners/ operators discontinue operation by ceasing to accept, treat, store, or dispose of hazardous waste.

(12) "Closure" means the act of securing a facility pursuant to the requirements of Subpart D.

(13) "Closure Procedures" means the measures which must be taken by facility owners/operators who no longer accept hazardous waste for treatment, storage, or disposal on the entire site.

(14) "Common Code" means the unique code assigned by the Chemical Abstract Services to each EPA hazardous waste and to each DOT hazardous waste material listed in Section 250.14 of Subpart A.

(15) "Container" means any portable enclosure in which a material can be stored, handled, transported, treated, or disposed.

(16) "Contamination" means the degradation of natural water, air, or soil quality as a result of man's activities, to the extent that its usefulness is impaired.

(17) "Cover Material" means soil or other suitable material that is used to cover hazardous waste.

(18) "Delivery Document" means a shipping paper (Bill of Lading, Waybill, Dangerous Cargo Manifest, etc.), used in lieu of the original manifest.

(18a) "Direct Contact" - (space reserved)

(19) "Disposal of Solid or Hazardous Waste" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

(20) "Disposal Facility" means any facility which disposes of hazardous waste.

(21) "EPA" means the U.S. Environmental Protection Agency.

(22) "EPA Region" means the states found in any one of the following ten regions:

(1) Region I - Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island.

(2) Region II - New York, New Jersey, and Puerto Rico.

(3) Region III - Pennsylvania, Maryland, West Virginia, and Virginia.

(4) Region IV - Kentucky, Tennessee, North Carolina, Mississippi, Alabama, Georgia, South Carolina, and Florida.

(5) Region V - Minnesota, Wisconsin, Illinois, Michigan, Indiana, and Ohio.

(6) Region VI - New Mexico, Oklahoma, Arkansas, Louisiana, and Texas.

(7) Region VII - Nebraska, Kansas, Missouri, and Iowa.

(8) Region VIII - Montana, Wyoming, North Dakota, South Dakota, Utah, and Colorado.

(9) Region IX - California, Nevada, Arizona, Hawaii, and Guam.

(10) Region X - Washington, Oregon, Idaho, and Alaska.

(23) "Facility" means any land and appurtenances thereto used for the treatment, storage, and/or disposal of hazardous waste.

(24) "Final Cover" means cover material that is applied upon closure of a landfill and is permanently exposed to the surface.

(25) "Five Hundred Year Flood" means a flood that has a 0.2 percent or one in 500 chance of recurring in any year, or a flood of magnitude equalled or exceeded once in 500 years on the average over a significantly long period. In any given 500-year interval, such a flood may not occur, or more than one such flood may occur.

(26) "Flash Point" means the lowest temperature at which evaporation of a substance produces sufficient vapor to form an ignitable mixture with air, near the surface of the liquid. Ignitable mixture denotes a mixture that, when ignited, is capable of the initiation and propagation of flame away from the source of ignition. Propagation of flame means the spread of the flame from layer to layer independently of the source of ignition.

(27) "Food Chain Crops" means pasture, forage or feed grain used to feed animals which are raised for human consumption or used to produce products for human consumption, as well as food or tobacco crops for human consumption.

(28) "Freeboard" means the vertical distance between the normal maximum level of the surface of the liquid in a surface impoundment, basin, open tank, etc. and the top of the dike or top of the sides of an impoundment, basin, open tank, etc.

(29) "Fugitive Emissions" means air contaminant emissions other than those from stacks, ducts, or vents or from non-point emission sources.

(30) "Generator" means any person or Federal agency whose act or process produces hazardous waste (as identified or listed under Subpart A of this part); however, a person or Federal agency who produces and disposes of no more than 100 kilograms (approximately 220 pounds) per month of hazardous waste (as identified or listed under Subpart A of this part) is not a generator.

(31) "Groundwater" means water beneath the land surface in the saturated zone.

(32) "Hazardous Waste" means hazardous waste as defined in Subpart A.

(33) "Hazardous Waste Facility Personnel" means those persons responsible for performing and/or overseeing operations at a hazardous waste treatment, storage or disposal facility, and whose actions or

failure to act may result in damage to human health or the environment.

(34) "Hazardous Waste Landfill" means an excavated or engineered area on which hazardous waste is deposited and covered.

(35) "Hazardous Waste Leachate" means the liquid that has percolated through or drained from hazardous waste emplaced in or on the ground.

(36) "Hydraulic Gradient" means the change in hydraulic pressure per unit of distance in a given direction.

(37) "Identification Code" means the unique code assigned by EPA to each generator, transporter, and treatment, storage, or disposal facility, pursuant to Subpart G regulations.

(38) "Incinerator" means an engineered device using controlled flame combustion to thermally degrade hazardous waste. Examples of devices used for incineration include rotary kilns, fluidized beds, liquid injection incinerators, pathological incinerators, cement kilns, and utility boilers.

(39) "Incompatible Waste" means a waste unsuitable for commingling with another waste or material, where the commingling might result in:

(1) extreme heat or pressure generation,

(2) fire,

(3) explosion or violent reaction,

(4) formation of substances which are shock-sensitive, friction-sensitive, or otherwise have the potential of reacting violently,

(5) formation of toxic dusts, mists, fumes, gases, or other chemicals, and

(6) volatilization of ignitable or toxic chemicals due to heat generation, in such a manner that the likelihood of contamination of groundwater, or escape of the substances into the environment, is increased.

(40) "Landfarming of a Waste" means application of waste onto land and incorporation into the surface soil. Synonyms include land application, land cultivation, land irrigation, land spreading, soil-farming, and soil incorporation.

(41) "Liner" means a layer of emplaced materials beneath a surface impoundment or landfill which serves to restrict the escape of the wastes or its constituents from the impoundment or landfill.

(42) "Manifest" means the form used for identifying the quantity, composition, and the origin, routing and destination of hazardous waste as specified in regulations under Section 250.43-6, Subpart B of this part.

(43) "Manifest Document Number" means the unique serially increasing number assigned to the manifest by the generator for recordkeeping and reporting purposes.

(44) "Monitoring" means all procedures used to systematically inspect and collect data on operational parameters of the facility or on the quality of the air, groundwater, or surface water.

(45) "Monitoring Well" means a well used to obtain water samples for water quality analysis or to measure groundwater levels.

(46) "Navigable Waters" means "waters of the United States, including the territorial seas," as defined in 43 FR page 37090.

(47) "Non-point Source" means a source of air contaminant emissions other than those from stacks, ducts, or vents resulting from disposal and treatment of hazardous wastes, including, but not limited to, landfills, landfarms, surface impoundments, and basins.

(48) "One Hundred Year Flood" means a flood that has a one percent or one in 100 chance of recurring in any year, or a flood of magnitude equalled or exceeded once in 100 years on the average over a significantly long period. In any given 100-year interval, such a flood may not occur, or more than one such flood may occur.

(49) "On-site" means on the same geographically contiguous property. Two or more pieces of property which are geographically contiguous and are divided by public or private right(s)-of-way are considered a single site.

(50) "Open Burning" means the combustion of any material without the following characteristics:

(1) control of combustion air to maintain adequate temperature for efficient combustion,

(2) containment of the combustion-reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion, and

(3) emission of the gaseous combustion products through a stack duct or vent adequate for both visual monitoring and point source sampling.

(51) "Owner/Operator" means the person who owns the land on which a facility is located when that person is responsible for the overall operation of the facility.

(52) "Partial Closure Procedures" means the measure which must be taken by facility owners/operators who no longer accept hazardous waste for treatment, storage or disposal on a specific portion of the site.

(53) "Permafrost" means permanently frozen subsoil.

(54) "Point Source" means a source of air contaminant emissions from stacks, ducts, or vents resulting from disposal and treatment of hazardous wastes.

(55) "Post-Closure Care" means the monitoring and facility maintenance activities conducted after closure.

(56) "POTW" (space reserved.)

(57) "Reactive Hazardous Wastes" means (as defined in Subpart A):

(1) wastes which in themselves are normally unstable and readily undergo violent chemical change, but do not detonate, as well as wastes which may react violently with water, or which may form potentially explosive mixtures with water, or which generate toxic fumes when mixed with water;

(2) wastes which in themselves are capable of detonation or explosive reaction, but require a strong initiating source or which must be heated under confinement before initiation, or which react explosively with water;

(3) wastes which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.

(57a) "Recharge Zone" (space reserved)

(58) "Regional Administrator" means the Regional Administrator of the Environmental Protection Agency Region in which the facility concerned is located, or his designee.

(59) "Reporting Quarter" means the three (3) month time period covered by each quarterly report; the reporting quarter shall end on the last day of March, June, September, and December.

(60) "Reporting Year" means the twelve month time period covered by each annual report; the reporting year shall end on the last day of September.

(61) "Retention Time" means the time hazardous wastes are subjected to the combustion zone temperature.

(62) "Run-off" means the portion of precipitation that drains over land from an area as surface flow.

(63) "Saturated Zone (Zone of Saturation)" means that part of the earth's crust in which all voids are filled with water.

(64) "Scavenging" means the unauthorized removal of hazardous waste materials from a facility.

(65) "Spill" means any accidental discharge of hazardous wastes onto or into the land or water.

(66) "Soil Conditioning Products" means fertilizers, soil amendments or related products used for the purpose of improving the quality of the soil.

(67) "Sole Source Aquifers" means those aquifers designated in Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523) which solely or principally supply drinking water to a large percentage of a populated area.

(68) "Storage of Hazardous Waste" means the containment of hazardous waste either on a temporary basis or for a period of years in such a manner as not to constitute disposal of such hazardous waste.

(69) "Storage Facility" means any facility which stores hazardous wastes, except generators who store their own wastes for less than 90 days for subsequent transport off-site.

(70) "Storage Tank" means any manufactured non-portable covered device used for containing pumpable hazardous wastes.

(71) "Surface Impoundment" means any natural depression or excavated and/or diked areas built into or upon the land, which are fixed, uncovered, and lined with soil or a synthetic material, and are used for treating, holding, or disposing waste. Examples include holding ponds and aeration ponds (not landfills).

(72) "Training" means formal instruction, supplementing an employee's existing job knowledge, designed to protect human health and the environment via increased awareness and improved job proficiency.

(73) "Transporter" means a person or Federal Agency engaged in the transportation of hazardous waste by air, rail, highway, or water.

(74) "Treated Area of a Land Farm" means that portion of the landfarm that has had hazardous waste applied to it, to include the zone of incorporation.

(75) "Treatment of a Hazardous Waste" means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume. Such term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it nonhazardous.

(76) "Treatment Facility" means any facility which treats hazardous waste.

(77) "True Vapor Pressure" means the pressure exerted when a solid and/or liquid is in equilibrium with its own vapor. The vapor pressure is a function of the substance and of the temperature.

(78) "24-hour, 25-year Storm" means a storm of 24-hour duration whose frequency of occurrence is once in 25 years.

(79) "Unsaturated Zone (Zone of Aeration)" means interstices occupied partially by water and partially by air; it is the zone between the land surface and the nearest saturated zone.

(80) "United States" means the 50 States, District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

(81) "UDWS" means an Underground Drinking Water Source as defined in the Underground Injection Control (UIC) Draft Regulations (40 CFR 146.02(r)) as follows:

(1) an aquifer which currently supplies a public water system; or

(2) an aquifer which contains water having less than 10,000 mg/l total dissolved solids; or

(3) any aquifer designated as usable by the Administrator after a public hearing. (Additional details will be supplied at a later date.)

(82) "Vapor Recovery System" means a vapor gathering system capable of collecting vapors and gases discharged from a storage tank, and a vapor processing system capable of processing such vapors and gases so as to prevent their emission to the atmosphere.

(83) "Water Table" means the upper surface of the zone of saturation in an unconfined aquifer at which the pressure is equal to atmospheric pressure.

(84) "Wetlands" means those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do or would support, a prevalence of vegetation typically adapted for life in saturated or seasonally saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river outflows, mudflats, and natural ponds.

(85) "Zone of Incorporation" means the depth to which the soil on a landfarm is plowed or tilled to receive waste.

"For purposes of this part, all terms not herein defined shall take the meaning given them by the Solid Waste Disposal Act (P.L. 94-580)."

250.42 HUMAN HEALTH AND ENVIRONMENTAL STANDARDS

(1) All owners/operators of all facilities which treat, store, or dispose of hazardous waste as identified or listed in Subpart A shall under all circumstances comply with all the human health and environmental objectives.

(2) Facility owner/operators who are in compliance with all applicable standards shall not be required to prove that he/she is in compliance with the human health and environmental objectives.

250.42-1 Groundwater, Human Health, and Environmental Standard

The objective of this section is to assure that facilities are located, designed, constructed and operated in such a manner that they do not degrade any groundwater such that Underground Drinking

Water Sources (UDWS) anywhere outside the facility property would at any time in the future be endangered. A treatment, storage or disposal practice "endangers" a UDWS if:

(1) such practice would result in a public water system not complying, now, or in the future, with any National Primary Drinking Water regulation (see Annex 1: EPA Interim Drinking Water Standards); or

(2) such practice may make it necessary for a person using a UDWS to treat or increase treatment of the water; or

(3) such practice might make it necessary for a person who uses the UDWS in the future to treat or more extensively treat the water than would otherwise have been necessary; or

(4) such practice may otherwise adversely affect the health of persons, such as by adding a substance that would make the water from the UDWS unfit for human consumption.

(The final form of the above objective is dependent upon the eventual promulgation of UIC regulations.)

250.42-2 Surface Water, Human Health, and Environmental Standard

All facilities shall be located, designed, constructed and operated in such a way that any surface or substance discharge from the facility into waters of the United States does not at any time cause a violation of Water Quality Standard promulgated or approved under Section 303 of the Clean Water Act, or constitute a spill of hazardous substances under Section 311 of the Clean Water Act.

250.42-3 Air, Human Health, And Environmental Standard

The objective of this section is to assure that facilities are located, designed, constructed, and operated in such a manner that:

(a) air emissions from such facilities do not adversely affect human health or the environment; and

(b) non-point emission sources shall not contribute any air contaminant to the atmosphere in concentrations exceeding the Threshold Limit Value (TLV) for that air contaminant, as published by the American Conference of Governmental Industrial Hygienists (ACGIH), or contribute two or more listed air contaminants in a manner which causes the following equation to produce a sum exceeding unity:

$$\frac{C_1}{L_1} + \frac{C_2}{L_2} + \cdots + \quad \frac{C_n}{L_n}$$

where,

C_1, C_2..., and C_n are concentrations at the surface of the non-point source and L_1, L_2, and L_n are the corresponding Threshold Limit Values for those air contaminants (see Annex 2).

250.42-4 Commercial Products, Human Health, And Environmental Standard

The objective of this section is to assure that commercial products made from hazardous waste shall not result in degradation of surface water, groundwater, air, and land, or adversely affect human health to a level which exceeds that resulting from the use of the virgin product being replaced.

250.43 GENERAL FACILITY STANDARDS

(a) All facilities shall be located, designed, constructed, and operated such that discharge to the groundwater does not occur, unless the facility owner/operator can demonstrate that the discharge will not cause the groundwater human health and environmental standard (250.42-1) to be violated.

(b) All facilities with point source discharges, including discharges from leachate collection systems and/or surface run-off collection systems, to navigable waters shall comply with the regulations promulgated under the Clean Water Act of 1977 (P.L. 95-217). Additionally, facilities with discharges to municipal sewer systems shall meet applicable pretreatment standards and have the approval of the municipal sewer system authority.

(c) Diversion structures capable of diverting, from the active portions of facilities, surface water run-off from a 24-hour, 25-year storm shall be constructed and maintained.

Note: Facility owners/operators do not need to construct such diversion structures if they can demonstrate that surface water run-off will not enter the facility such that it damages the facility or causes the surface water human health and environmental standard to be violated.

(d) Surface water run-off from active portions of facilities shall be collected and confined to a point source before discharge.

Note: Facility owners/operators do not have to collect and confine surface water over active portions if they can demonstrate that alternatives will not allow the surface water and groundwater human health and environmental standards to be violated.

(e) Open burning of hazardous waste is prohibited unless the facility can demonstrate compliance with the air human health and environmental standard (250.42-3).

(f) All facilities shall comply with applicable standards of the Clean Air Act and its provisions.

(g) Any person who generates or removes a hazardous waste from a facility shall comply with the requirements of Subpart B, Section 3002 (Standards Applicable to Generators).

(h) All facility owners and operators shall obtain an analysis of each type of waste from each source. This analysis shall identify the principal hazardous components and characteristics of the waste, as is necessary for the facility owner/operator to comply with the requirements of this Subpart.

(i) All facility owner/operators shall sample each shipment or batch of waste received at the facility in order to confirm that the contents of the shipment or batch matches the analysis required in paragraph (h) above.

(j) Facility owner/operators shall close (as specified in 250.43-8) all portions of their facilities which do not comply with these regulations.

250.43-1 General Site Selection

(a) Facilities shall not be located on or near active fault zones.

(b) In accordance with Executive Order 11988, "Floodplain Management," facilities shall not be located in a 100-year floodplain.

Note: Facilities may be located in 100-year floodplains if it can be demonstrated that the facility will not restrict the flow of a 100-year flood or reduce the temporary water-storage capacity of the floodplain such that increased flooding upstream or downstream may result from the 100-year flood.

(c) In accordance with Executive Order 11988, "Floodplain Management," facilities shall not be located in a 500-year floodplain.

Note: Facilities may be located in 500-year floodplains if it can be demonstrated that the facility is designed, constructed, operated, and maintained such that the facility will not be inundated by a 500-year flood.

(d) In accordance with Executive Order 11990, "Protection of Wetlands," facilities shall not be located in wetlands.

Note: Facilities may be located in wetlands if:

(1) The facility obtains an NPDES permit under Section 402 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500, 86 Stat. 880, 33 U.S.C. 1342); and

(2) If a levee or other type of containment structure is to be placed in the water as part of the disposal activity, the facility obtains a permit issued under authority of Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500, 86 Stat. 884, 33 U.S.C. 1344), according to the Army Corps of Engineers Permits for Discharges of Dredged or Fill Material into Waters of the United States (33 CFR Part 323).

(e) Facilities shall not be located in a permafrost area.

Note: Facilities may be located in a permafrost area if:

(1) Other alternatives, such as recycling or salvaging of materials, energy recovery of combustibles, and transport of the waste to more temperate regions are evaluated and determined to be technically or economically infeasible; and

(2) The facility is located on relatively dry and workable soils where minimal or no vegetative cover exists, and the facility is designed, constructed and operated so as to minimize erosion and to minimize surface areas consumed.

(f) Facilities shall not be located in a critical habitat area listed in 50 CFR Part 17, Subpart F: Critical Habitat, 1760 et seq.

Note: Facilities may be located in critical habitat areas if:

(1) It can be demonstrated that such treatment, storage, or disposal operations will not jeopardize the continued existence of endangered species; and

(2) Approval of the treatment, storage or disposal plan is obtained from the Office of Endangered Species, U. S. Fish and Wildlife Service, Department of the Interior.

(g) Facilities shall not be located in the recharge zone of a sole source aquifer.

Note: Facilities may be located in the recharge zones of sole source aquifers if it can be demonstrated that the facility is located, designed, constructed, operated, maintained and monitored to prevent endangerment of the aquifer.

(h) Active portions of facilities shall be located a minimum of 200 feet from the facility's property line.

Note: Facilities may locate active portions of their facilities closer than 200 feet from their property line if it can be demonstrated that such facility location will not cause the groundwater (250.43-1) or surface water (250.43-2) human health and environmental standards to be violated.

250.43-2 Financial Requirements

(a) Continuity of Operation

(1) Requirements for Facility Closure

(i) Cost Estimation

Each owner or operator of a hazardous waste treatment, storage or disposal facility shall file as a part of his or her application for a permit an estimate of the costs of closing the site, for which the permit is sought, after its capacity is reached or operations have otherwise terminated, in accordance with the requirements of Section 250.43-8 of this subpart. The Regional Administrator will evaluate this cost estimate and either accept the estimate as made or after revision, in accordance with his or her evaluation.

(ii) Financial Assurance for Facility Closure

Each facility owner or operator shall establish a secured trust fund designated, "in trust for the closure of (the permitted hazardous waste treatment, storage, or disposal facility)." A bank or other financial institution approved by the Regional Administrator shall act as the trustee of the closure trust fund. Disbursements from the closure trust fund are allowable only upon the Regional Administrator's written approval.

Each owner or operator shall deposit into the trust fund, as a condition of receiving a permit, a cash deposit equal to the cost estimate for closure, multiplied by the appropriate present value factor from Table 1. If life of the site exceeds 20 years, the present value factor can be determined by using the following formula:

$$\mathrm{PVF} = \frac{1}{1.02}\ \mathrm{SL}$$

where: PVF = present value factor

SL = site life in years

Table 1

Site Life in Years	Present Value Factor
1	.980
2	.961
3	.942
4	.924
5	.906
6	.888
7	.871
8	.853
9	.837
10	.820
11	.804
12	.788
13	.773
14	.758
15	.743
16	.728
17	.714
18	.700
19	.686
20	.673

(iii) Reimbursement for Closure Costs

When an owner or operator has ceased operations at a hazardous waste management facility and has completed closure of the site, as required under Section 250.43-8 of the subpart, he or she may apply to the Regional Administrator for return of the funds, principal and interest, in the closure trust fund. Upon determination that closure has been satisfactorily accomplished, the Regional Administrator may release all funds accumulated in the trust fund.

(2) Requirements for Post Closure Monitoring and Maintenance

(i) Cost Estimation

Each owner or operator of a hazardous waste disposal facility shall file with the Regional Administrator, as part of his or her application for a permit, an estimate of the annual cost of post closure monitoring and routine maintenance at the site in accordance with the closure regulations in Sections 250.43-8 of this subpart. The Regional Administrator will evaluate the cost estimate, and after such modification as may be necessary in light of his or her evaluation, give notice of acceptance of the cost estimate. This value which will be referred to as the annual post closure operating cost will then be used to determine the annual cash payments into a trust fund for monitoring and maintenance as required under Section 250.43-8 of this subpart for a period of twenty years after facility closure.

NOTE: By definition, hazardous waste treatment and storage facilities will have no need to conduct post closure monitoring and maintenance since all wastes will be removed from the facility at the time of closure.

(ii) Financial Assurance for Post Closure Monitoring and Maintenance

Each owner or operator of a hazardous waste disposal facility shall further designate the closure trust fund established under Section 250.43-1 (a)(1)(ii), "in trust for the post closure monitoring and maintenance of (the permitted hazardous waste disposal facility)." The period of payment into this portion of the trust fund shall be equal to the length of life of the site except when the life of the site exceeds twenty (20) years in which case the period of payment into the trust fund shall be twenty years. Equal, annual cash payments shall be made into the trust fund from the end of the first year of site operation until the end of the period of payment. If for any reason the required annual payment is not made, the trustee shall notify the Regional Administrator. The amount of the annual cash payment shall be calculated by multiplying the annual post closure operating costs as determined under Section 250.43-2 (a)(2)(i) by 16.35, and dividing the product by the Sum of Annuity factor appropriate to the period of payment in Table 2.

(iii) Reimbursements for Post Closure Costs

One year after completion of closure, in compliance with 250.43-8 of this subpart, and annually thereafter, for a period of twenty years, an owner or operator who has carried out all necessary

Table 2

Period of Payment	Sum of Annuity Factor
1	1.000
2	2.020
3	3.060
4	4.122
5	5.204
6	6.308
7	7.434
8	8.583
9	9.755
10	10.950
11	12.169
12	13.412
13	14.680
14	15.974
15	17.293
16	18.639
17	20.012
18	21.412
19	22.841
20	24.297

post closure maintenance and monitoring as required under Section 250.43-8 of this subpart, upon application to the Regional Administrator, may be reimbursed out of the funds in the trust fund, an amount equal to the costs for monitoring and routine maintenance for that year. Requests for release of funds for reimbursement must be accompanied by an itemized list of costs incurred. Upon determination that the expenditures incurred are in accordance with the approved plan and/or are justified, the Regional Administrator may release the funds. Any funds remaining in the trust at the end of the twentieth year will likewise be released.

(3) Access and Default

As a condition of issuance of any permit pursuant to these regulations, a permit holder shall be deemed to have granted to the Administrator, his employees and agents the right to enter upon the site covered by the permit and carry out the closure and post-closure monitoring and operations otherwise required of the permit holder in the event of the permit holder's default on closure or abandonment of the site following its closure. In the event of default on these requirements on the part of the permit holder or abandonment of the site, all regulatory requirements are transferred to the owner of the site. In the event that the site owner or the permit holder cannot be reached within 48 hours of attempt to serve a compliance order respecting closure or post closure responsibilities, EPA may directly use part or all of the funds accumulated in the fund to accomplish the regulatory requirements.

(b) Financial Responsibility

(1) Financial Responsibility Required of Owners or Operators During Site Operation

Each owner or operator of a hazardous waste treatment, storage or disposal facility shall have and shall maintain financial responsibility in the minimum amount of $5 million for claims arising out of injury to persons or property from the release or escape of hazardous wastes to the environment. This includes those clean up costs which are a legal obligation of the facility owner or operator.

(i) Establishment of Financial Responsibility

Financial responsibility may be established by any one, or a combination, of the following:

1) Evidence of liability insurance
2) Self insurance
3) Other evidence of financial responsibility.

Evidence of financial responsibility acceptable to the Regional Administrator must be maintained during the operation of a hazardous waste treatment, storage or disposal facility. The level of self insurance shall not exceed 10 percent of equity.

(2) Establishment of Post Closure Financial Responsibility for Hazardous Waste Disposal Facilities

(Reserved)

250.43-3 Security

(a) Facilities shall have fencing completely surrounding the active portions of the facility.

> NOTE: Facilities do not have to comply with the above standard (250.43-3(a)) if the owner/operator can demonstrate that the facility in question is surrounded by a natural or artificial barrier capable of preventing scavenging, unpermitted treatment, storage or disposal activity, the unknowing entry of persons, domestic livestock, or any other unauthorized entry.

(b) Ingress through each gate or other access shall be controlled by an attendant, mechanical or electro-mechanical device whenever the facility is in operation (e.g., security personnel, key cards, or television monitors, respectively). Each gate or other access shall be secured whenever the facility is not in operation.

(c) A sign, in the English language and the predominant language of the area surrounding a facility (e.g., facilities in states bordering Mexico and Canada shall have signs posted in Spanish and French, respectively), having the following legend - (WARNING - Unauthorized Personnel Keep Out) - shall be posted about the active portions of the facility. The sign shall consist of block letters not less than four (4) inches in height. The letters shall be of a color offering high contrast with the background color of the sign.

NOTE: Facilities may deviate from the specified four (4) inch block letters and legend of the sign as specified in Standard 250.43-3(d), provided that the facility owner/operator can demonstrate that the proposed alternative sign in question is legible and clearly visible from each and every access onto a facility and that the sign warns against unauthorized entry or is unnecessary in light of the standards.

250.43-4 Emergency Procedures and Contingency Plans

(a) Contingency plans

(1) The facility owner/operator shall develop a contingency plan for his facility so as to minimize human health or environmental damage in the event of an accidental discharge. The provisions of the plan shall be followed, as appropriate, in the event of an emergency at the facility.

(2) A copy of the contingency plan shall be filed with the EPA Regional Administrator and with all local police departments, fire departments, hospitals and hazardous incident response teams (H.I.R.T.) who may be called upon to provide emergency services. All revisions to the plan shall be promptly reported in writing to all affected parties having copies of the contingency plan.

(3) The plan shall describe arrangements made with local police departments, fire departments, hospitals, and hazardous

incident response teams (H.I.R.T.) to coordinate emergency services. These arrangements shall include:

(i) familiarization of police, fire departments, and hazardous incident response teams (H.I.R.T.) with facility layout, wastes handled at the facility and associated hazards, places where facility personnel would normally be working, entrances and roads inside the facility, possible evacuation routes, etc.; and

(ii) where necessary, agreements designating primary emergency authority to one police and one fire department jurisdiction in the event that more than one responds to the emergency, and agreements with any others to provide support to the primary authority.

NOTE: Arrangements need not be made with local police agencies, fire departments, hospitals and hazardous incident response teams (H.I.R.T.) if the owner/operator can demonstrate that hazards do not exist at the facility which necessitate the services of the above mentioned organizations.

(4) At all times when the facility is in operation, there shall be at least one person present with the reponsibility of coordinating all emergency response measures. This emergency coordinator shall be thoroughly familiar with all aspects of the facility's contingency plan, all operations activities at the

facility, location and characteristics of wastes handled, location of manifests within the facility, and facility layout.

(5) The names, addresses, and phone numbers (office and home) of all persons qualified to act as emergency coordinators under (a)(4) above shall be listed in the contingency plan submitted for each facility.

(6) The plan shall include a list, physical description, and description of capabilities of all emergency equipment at the facility, including fire extinguishing systems, alarms (internal and external), decontamination equipment, etc.

(7) The plan shall include an evacuation plan for facility personnel and outlining evacuation routes, signals(s) to be used to begin evacuation, and alternate evacuation routes if the primary routes can potentially be blocked by fires, spills, etc., of hazardous waste.

(8) The plan shall include an outline of a program for familiarizing employees with emergency procedures (alarm signal, shutdown of operations, evacuation) and for drills on these procedures.

(b) Preparedness and Prevention

(1) All facilities shall be equipped with the following:

(i) An alarm or other communications system capable of summoning external emergency assistance (i.e., local police departments, fire departments, and hazardous incident response teams; and

NOTE: An alarm or other communication system is not needed if the facility owner/operator can demonstrate that hazards at the facility requiring external emergency assistance do not exist.

(ii) an internal communications system capable of providing immediate emergency instruction (voice or signal) to facility employees.

(2) At any time that hazardous waste is being poured, mixed, spread, or otherwise handled, all employees involved in the operation shall have immediate access to an internal or external alarm or emergency communication device, either directly or through visual or voice contact with another employee. If at any time during operation of the facility there is a sole employee on the premises, he/she shall have immediate access to an alarm or other communication device capable of summoning external emergency assistance.

(3) Facilities shall have the following:

(i) portable fire extinguishers, fire control equipment, and spill control equipment;

(ii) water at adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems; and

(iii) special extinguishing equipment, such as that utilizing foam, inert gas, or dry chemical.

NOTE: Fire extinguishing equipment, fire control equipment, and spill control equipment is not needed if the facility owner/operator can demonstrate that hazards at the facility which necessitate the need for such equipment do not exist.

(4) All facility fire protection equipment shall be adequately maintained and periodically inspected and tested to make sure it is always in satisfactory operating condition, and that it will serve its purpose in time of emergency.

(5) Adequate aisle space shall be maintained for unobstructed movement of personnel, and maintained so that fire protection equipment can be brought to bear on any area of facility operation.

NOTE: Aisle space need not be maintained for unobstructed movement of personnel and protection equipment if the facility owner/operator can demonstrate that the aisle space is not necessary for the movement of personnel and it is not necessary to bring in fire equipment.

(6) Precautions shall be taken to prevent accidental ignition of ignitable materials. Sources of ignition, including but not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat, shall be

eliminated or protected against facilities where a flammable atmosphere could be created.

(7) While ignitable or reactive wastes are being handled, smoking shall not be permitted and no one near the wastes shall possess matches, open light, or other fire or flame. Smoking and open flame shall be prohibited at the facility except in designated localities. "No Smoking" signs shall be conspicuously posted where hazard from ignitable or reactive liquid vapors is normally present.

(c) Response and Recovery

(1) In the event of an accidental discharge, the facility's emergency coordinator shall identify the character, exact source, volume and extent of the discharged materials by review of facility records and manifests, and if necessary, by chemical analysis.

(2) The emergency coordinator shall assess possible hazards to local communities associated with a discharge. This assessment shall include consideration of indirect effects, such as toxic, irritating, or asphyxiating gases, hazardous surface run-off due to water or chemical agents used to control fire, and heat-induced explosions.

(3) The emergency coordinator shall determine what actions should be taken to mitigate damage or injury to the community and its residents. This determination shall indicate whether:

(i) local communities may have been exposed to a hazardous substance; and

(ii) evacuation of local populated areas should be initiated because of imminent danger (i.e., from toxic combustion products, ignitable or explosive vapors, threatened explosions, etc.).

(4) The emergency coordinator shall notify appropriate agencies with designated response roles immediately if an emergency at the facility presents a potential threat to local populated areas, or if their assistance is necessary.

(5) The emergency coordinator shall notify appropriate local authorities immediately if his/her assessment indicates that evacuation of local areas may be advisable. The emergency coordinator shall be prepared to assist authorities in making the final determination as to whether evacuation is necessary.

(6) Where applicable, the emergency coordinator shall activate internal facility alarms or communications systems to notify all personnel of imminent or actual emergency situations.

(7) In the event that a facility has a fire, spill or explosion which has the potential for endangering human health or the environment, the emergency coordinator shall telephone the United States Coast Guard National Response Center's twenty-four (24) hour toll free number, 800-424-8802, to report such an incident immediately after discovery of its occurence.

(8) The emergency coordinator shall take all reasonable measures necessary to ensure that fires and explosions do not reoccur and do not spread to other hazardous wastes at the facility. These shall include, where applicable, cessation of processes and operations, collection and containment of discharged wastes, removal or isolation of containers, etc.

(9) The emergency coordinator shall record the time, date, and nature of the emergency, and convey a preliminary report with this and any other pertinent information on the emergency to the Regional Administrator, as required in Section 250.43-6 of this subpart.

(10) The emergency coordinator shall provide for treatment, storage or disposal of recovered wastes, contaminated soil, or materials resulting from an accident at the facility after the recovered wastes, contaminated soil or contaminated materials have been:

(i) analyzed to determine whether it is a hazardous waste, or

(ii) assumed to be a hazardous waste.

(11) The emergency coordinator shall ensure that no wastes which may be incompatible with the released material are accepted for treatment, storage or disposal at the facility until clean-up procedures are completed, emergency equipment restored to pre-accident condition, and the affected area is declared safe by EPA or other appropriate regulatory authorities.

(12) Where applicable, the emergency coordinator shall, subsequent to shut-down of operations, in response to a fire, spill or explosion, monitor for leaks, pressure build-up, gas generation or ruptures in valves, pipes or other equipment.

(13) The emergency coordinator shall ensure that all emergency equipment, including vehicles, pumps, temporary storage containers, etc., are cleaned and restored to pre-accident condition before operations may be resumed.

250.43-5 Training

(a) Within six (6) months after the effective date of these regulations or date of employment, personnel at new and existing facilities shall have attended and successfully completed a course of instruction in hazardous waste management procedures relevant to the operation of the facility at which they are employed.

(b) Owners/operators of facilities for the treatment, storage or disposal of hazardous wastes shall:

(1) maintain the following records, and make them available to the Regional Administration upon request:

(i) a list of the job titles of all positions at the facility related to hazardous waste management;

(ii) a written job description for each position listed under (b)(i) which shall include the requisite skills, education, responsibilities and duties related to each position;

(iii) a written description of the type and quantity of introductory and continuing training that will be administered to each person filling a position listed under (b)(i);

(iv) records that document that the training required under (a), has been administered to facility personnel;

(2) have their personnel trained in contingency procedures as prescribed in the facility's contingency plan required under Section 250.43-4; and

(3) have their personnel take part in an annual review and update of their initial training in contingency procedures and other areas as needed.

250.43-6 Manifest System, Recordkeeping and Reporting

(a) Manifest System

(1) Owners/operators of treatment, storage and disposal facilities which receive hazardous waste accompanied by a manifest or a delivery document shall:

(a) provide at least one (1) copy of the manifest or delivery document, after it has been signed and dated by an authorized representative of the facility, to the transporter as certification of receipt of the shipment covered by the manifest or delivery document.

(b) forward, within thirty days, one (1) copy of the manifest or delivery document, after it has been signed and dated by an authorized representative of the facility to the generator as certification of receipt of the shipment covered by the manifest or delivery document.

(c) note in the comments section of the manifest or delivery documents discrepancies such as variations in type and/or quantity of hazardous waste designated on the manifest or delivery document by the generator, and the type and/or quantity actually received by the treatment, storage or disposal facility (TSDF). The facility owner/operator shall notify the Regional Administrator immediately when such discrepancies are discovered by forwarding a copy of the manifest or delivery document.

(2) Owners/operators of TSDF's accepting off-site deliveries of hazardous waste for treatment, storage, or disposal shall retain for a period of three (3) years a copy of each manifest or delivery document as certified by the generator, transporter, and TSDF owner/operator.

(3) Owners/operators of TSFD's accepting off-site deliveries of hazardous waste accompanied by a manifest or delivery document shall:

(a) Make an annual report based upon the information designated on the manifests or shipping documents which were certified as received during the reporting year.

(b) Based on a summary of all shipments, send the annual report within four (4) weeks after the closing date to the EPA Regional Administrator having regulatory authority over the TSDF.

(c) Designate in their annual reports the following (see Annex 3 for the report form):

(i) The TSDF identification code, name, and address;

(ii) The closing date of the annual reporting period;

(iii) The identification code of each hazardous waste generator from which a hazardous waste was received during the reporting period. For international shipments, the name and address of the generator shall be designated.

(iv) The name and common code of each hazardous waste appearing on the manifest under "shipping description" which was received from each hazardous waste generator.

(v) The quantity of each hazardous waste received from each generator.

(vi) The units of volume or weight of each quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY).

(vii) In addition to the above, the TSDF owner/operator must make the following certification: "I certify that the above information is correct to the best of my knowledge and belief." In addition, the owner/operator must certify the information on the report by having an authorized representative of the generator sign and date it.

(4) Owners/operators of TSDF's accepting off-site deliveries of hazardous waste not accompanied by a manifest or delivery document shall make an immediate report of all such shipments of hazardous waste and send the report to the EPA Regional Administrator with regulatory authority over the TSDF. Owners/operators must designate in such reports the following (see Annex 3 for the TSDF Report Form):

(a) The TSDF identification code, name, and address;

(b) The closing date of the annual reporting period;

(c) The word "unmanifested" in place of the manifest document number on the TSDF Report Form;

(d) The name and address of the source;

(e) The name and common code of the hazardous waste (under "shipping description"), by its Department of Transportation (DOT) proper shipping name (49 CFR 172), or by the U.S. Environmental Protection Agency (EPA) name (as listed under Section 250.14 of Subpart A of this Part), if the DOT proper shipping name is not applicable.

However, if the DOT proper shipping "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name and common code (as listed under Section 250.14 of Subpart A of this Part) must also be designated on the manifest after the DOT proper shipping name NOS;

(f) The quantity of each hazardous waste received;

(g) The units of volume or weight of each quantity in pounds (P), tons (T), gallons (G), million gallons (MG), or cubic yards (CY);

(h) In addition to the above, the owner/operator of the TSDF must: (i) make the following certification: "I certify that the above information is correct to the best of my knowledge and belief."; and (ii) certify the information on the report by having an authorized representative of the owner/operator sign and date it;

(i) Note in the comments section of the TSDF Report Form a brief explanation of why the shipment was unmanifested.

(b) Recordkeeping

(1) Owners/operators of hazardous waste management facilities shall keep an operating log, to include all required information specified in 250.43-6(b)(2). This log shall at all reasonable times be open for inspection by the U.S. Environmental Protection Agency.

(2) The following data shall be recorded and maintained until closure of the facility:

(a) The record of hazardous waste treated, stored, or disposed of at the facility to include the following:

(i) A description of the hazardous waste by its U.S. Department of Transportation (DOT) proper shipping name (40 CFR 172), or by the U.S. Environmental Protection Agency (EPA) name (as listed under Section 250.14 of Subpart A of this Part), if the DOT proper shipping name is not applicable. However, if the DOT proper shipping name "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name (as listed under Section 250.14 of Subpart A of this Part) must also be designated on records after the DOT proper shipping name NOS;

(ii) The hazard class of each waste as identified or listed under the DOT hazard class (49 CFR 172), or by the EPA characteristics (as identified or listed under Section 250.13(a) and 250.14 of Subpart A of this Part) if the DOT hazard class is not applicable. However, if the DOT hazard class "OTHER REGULATED MATERIALS" (ORM) is used, the EPA characteristic (as identified or listed under Section 250.13(a) and 250.14 of Subpart A of the Part) must also be designated on records after the DOT hazard class ORM;

(iii) The quantity (as specified in 250.43-6(a)(3)(C)(vi)) of hazardous waste treated, stored or disposed, and the method of treatment, storage and disposal used for each waste.

(b) Locations, with respect to permanently surveyed benchmarks, where each type of waste is stored or disposed. The location of wastes in landfills shall be recorded as specified in Section 250.45-2(b)(3), and in ponds and lagoons as specified in Section 250.45-3(d)(3).

(c) Waste analyses, as specified in 250.43(h) and (i);

(d) Monitoring data, as required in 250.43-9;

(e) Summary reports and records of all incidents requiring initiation of a contingency plan, or resulting in human health or environmental damage;

(f) Records or results of visual inspections as required by Section 250.43-7(b).

(3) Records required under 250.43-6(b)(2)(a) and (b) specifying the location and types of disposed wastes shall be turned over to the EPA Regional Administrator upon closure of the facility.

(4) Records of operating conditions (temperature, pressure, residue time, feed rate, etc.) as required in 250.45 shall be maintained for a period of three (3) years.

(5) Training records required under 250.43-5(b)(i), (ii) and (iii), shall be maintained until closure of the facility.

Training records required under 250.43-5(b)(iv) shall be retained for a period of three (3) years; however, employee training records may accompany personnel transferred within the same company.

(c) Reporting

(1) Owners/operators of treatment, storage, or disposal facilities shall report all incidents, to include spills, fires and explosions, with the potential for human health or environmental damage or which require initiation of a contingency plan, to the National Response Center, U.S. Coast Guard, toll free, 800-424-8802, or to the government official predesignated in the applicable regional contingency plan pursuant to 40 CFR 1510 as the on-scene coordinator for the geographic area in which the incident occurs. Such reports shall be made immediately after discovery of each such occurrence.

(2) Owners/operators of treatment, storage, or disposal facilities shall report any problems detected by the monitoring system, such as a sustained increase over background conditions (See 250.43-9), to the EPA Regional Administrator within seven (7) days after discovery of each occurrence.

(3) Owners/operators of treatment, storage, and disposal facilities shall report monitoring data specified in 250.43 to the Regional Administrator quarterly.

(4) Owners/operators of treatment, storage, and disposal facilities shall notify the Regional Administrator prior to cessation of treatment and/or disposal operations, or prior to final facility closure as specified in 250.43-8.

250.43-7 Visual Inspections

(a) Owners/operators of facilities shall visually inspect, as applicable, the following:

(1) Storage areas for rust, corrosion, cracks in storage devices, missing or improper labels, and spills;

(2) Dikes and drainage systems;

(3) Operating and monitoring equipment and readings;

(4) Emergency response equipment;

(5) Damage to fences or barriers surrounding the facility;

(6) Damage to vegetation on or around the facility;

(7) Fugitive air emissions.

(b) Visual inspections shall be conducted daily and the results recorded in the facility's daily operating log.

250.43-8 Closure and Post Closure

(a) Facilities shall post a bond as described in Section 250.43-2, and this bond shall be held until completion of closure and post closure care is determined by the Administrator.

(b) Future use of land shall not be for residential, agricultural or any other purpose which disturbs the integrity of the closed facilities where hazardous waste has not been removed (i.e., landfills).

(c) All facilities shall be designed in such a manner that the land is amenable to some acceptable use so that perpetual isolation and care to maintain isolation are not required.

(d) Closure plans and procedures shall be submitted to the Administrator prior to beginning operations. Owners/operators of hazardous waste facilities, other than land disposal facilities, shall notify the Administrator at least 15 days before any partial closure operation and 90 days before final closure. Owners/operators of hazardous waste land disposal facilities shall notify the Administrator 15 days before any partial closure operation and 180 days before final closure. Closure plans shall include:

(1) A description of how the facility shall be closed.

(2) A description of possible uses of the land after closure. Note in 250.52-A shall apply.

(3) The anticipated time until closure and any anticipated partial closures.

(e) At close out, all disposal operations shall be completed, and all hazardous waste shall be removed from storage and treatment operations and disposed of as required in Subparts B, C, and D.

(f) Closure shall be completed within 3 years after close out.

(g) Upon completion of closure, all equipment used in the operation shall be properly disposed of or decontaminated by removal of all hazardous waste residues.

(h) After closure, all facilities shall be secured such that waste cannot be contacted by human or animal life and such that discharges of waste harmful to human health or the environment do not occur.

(i) After closure, all required equipment shall be provided and arrangements shall be made to continue groundwater montoring at landfarms, landfills, and other facilities where hazardous waste has been disposed of and has not been removed.

(j) Upon completion of closure and completion of post closure care, the facility owner/operator shall submit to the Administrator, certification by a registered professional engineer that the facility has been closed in accordance with the requirements of the facility permit.

(k) After closure, the facility owner/operator shall file a survey plan certified by a registered professional land surveyor with the county land authority and the Regional Administrator indicating what waste has been buried or farmed on the site, and the approximate location of such waste.

(l) Post closure care shall be continued by the owner/operator of a facility for a period not to exceed 20 years from the date of close out.

NOTE: The facility owner or operator may request that the Regional Administrator conduct a hearing to determine which post closure care requirements, if any, may be discontinued earlier than 20 years after close out. The facility owner or operator shall bring forth evidence that such post closure care need not continue, i.e., no leaks have been detected, or with advanced technology, which alternate disposal techniques are to be employed.

(m) Post closure care shall consist of at least the following:

(1) Monitoring for possible discharges.

(2) Maintenance of site security and waste containment devices.

250.43-9 Groundwater and Leachate Monitoring

All facilities other than landfarms which have the potential to discharge to groundwater shall be monitored so as to detect any discharge.

(a) Groundwater Monitoring

(1) A groundwater monitoring system consisting of four (4) monitoring wells shall be installed for the purpose of detecting discharges at all facilities.

(2) At least one background well shall be installed in an area hydraulically upgradient from the active portion of the facility so as to yield samples representative of the groundwater which will flow under the active portion of the facility.

(3) A minimum of three (3) monitoring wells shall be installed hydraulically downgradient of the active portion of each facility at different depths in order to detect leachate which may migrate into the saturated zone. Each well shall be constructed to draw samples from the depths where contamination is most likely to occur.

NOTE: Wells may be constructed to draw samples from a single depth only if it can be demonstrated that it is the depth where contamination is likely to occur.

(4) At least one downgradient well shall be positioned immediately adjacent to the active portion of the facility. The others shall be located to provide the greatest opportunity for interception of contamination.

(5) All monitoring wells shall be cased, and the annular space between the zone of saturation and the surface shall be completely backfilled with an impermeable material in order to prevent surface water from entering the well bore and to prevent inter-aquifer water exchange.

(b) Leachate Monitoring

(1) Leachate detection systems shall be installed under the primary liner or natural soil barrier of landfills and surface impoundments and above the water table.

NOTE: Leachate monitoring is not needed if the facility owner/operator can demonstrate that an alternative monitoring technique will detect leaks as effectively as a leachate monitoring system.

(2) Leachate monitoring systems shall be installed without drilling through the bottom and side liners or soil barriers of landfills and surface impoundments.

(c) Sampling and Analysis

(1) Samples from the monitoring well(s) and leachate monitoring systems shall be collected and analyzed comprehensively prior to treatment, storage, or disposal of any hazardous waste at a new facility in order to begin establishing baseline levels.

(2) Samples from the monitoring well(s) and leachate monitoring systems shall be collected and analyzed comprehensively at an existing facility within six months after the effective date of these regulations in order to begin establishing baseline levels.

(3) The baseline level of both groundwater and leachate (reflecting annual seasonal data) shall be established by conducting monthly comprehensive analyses for at least one year.

NOTE: Facility owner/operators may monitor less frequently if they can demonstrate that significant changes in groundwater quality will not occur.

(4) After the baseline has been established, groundwater samples shall be analyzed comprehensively at least once a year and the minimum analysis conducted at a frequency based on the groundwater flow rates shall be as follows:

A) Less than 25m (82 ft)/year - annually

B) 20-50m (82-164 ft)/year - semi-annually

C) Greater than 50m (164 ft)/year - quarterly

(5) After the baseline has been established, samples shall be collected from the leachate monitoring system quarterly and a minimum analysis conducted. A comprehensive analysis shall be conducted annually.

NOTE: This requirement is waived in the event that insufficient samples can be obtained for conducting the analysis.

(6) After the baseline has been established, if monitoring shows that the concentration of a chemical species has increased above baseline levels by a statistically significant amount, i.e., as determined by the Student's t single-tailed test at the 95% confidence level, the facility owner/operator shall:

A) notify the Regional EPA Administrator within 7 days;

B) determine the cause of the increase, e.g., the result of a spill, a design failure, an improper operating procedure, etc.;

C) determine the extent of the groundwater contamination.

(7) A minimum analysis shall quantify the following characteristics:

(A) Specific Conductivity, mho/cm at 25 C

(B) Temperature, C (Field and Laboratory)

(C) Total Dissolved Solids (TDS), mg/liter

(D) Chloride, mg/liter

(E) pH

(F) Dissolved Organic Carbon (DOC), mg/liter

(G) Two principle metals (ones found in the waste in the largest quantities or which best serve as indicators), mg/liter.

(8) A comprehensive analysis shall quantify the following characteristics:

(A) Specific Conductivity, mho/cm at 25 C

(B) Temperature, C (Field and Laboratory)

(C) pH

(D) Total Dissolved Solid, mg/liter

(E) Total Suspended Solid, mg/liter

(F) Total Settleable Solid, mg/liter

(G) Dissolved Organic Carbon (DOC), mg/liter

(H) Total Chlorinated Hydrocarbons, mg/liter

(I) Phenolic Compounds (as Phenol), mg/liter

(J) Metals:

Aluminum, mg/liter

Arsenic, mg/liter

Beryllium, mg/liter

Cadmium, mg/liter

Chromium, mg/liter

Copper, mg/liter

Iron, mg/liter

Magnesium, mg/liter

Manganese, mg/liter

Mercury, mg/liter

Nickel, mg/liter

Selenium, mg/liter

Silver, mg/liter

Zinc, mg/liter

(K) Ammonia (as N), mg/liter

(L) Chlorides, mg/liter

(M) Cyanide, mg/liter

(N) Floride, mg/liter

(O) Nitrate, mg/liter

(P) Nitrite, mg/liter

(Q) Phosphate, Total, mg/liter

(R) Ortho-phosphate (as P), mg/liter

(S) Organic Contamination scanning by Gas Chromatography.

NOTE: After the baseline level has been established, the comprehensive analysis may be reduced so as to eliminate any compounds not found in the waste handled at the facility.

(d) Recordkeeping and Reporting

(1) Owners/operators of facilities shall forward two copies of the monitoring data (Minimum Analysis and/or Comprehensive Analysis) to the EPA Regional Administrator quarterly using an appropriate format (an optional standardized form will be specified in Monitoring Manual).

(2) Owners/operators of facilities shall be required to retain for a minimum of 3 years any records of monitoring activities

and results, including all original strip chart recordings for instrumentation, calibration and maintenance of records.

250.44 STANDARDS FOR STORAGE

(a) Storage operations shall be conducted in such a manner that no discharge occurs.

(b) Storage facilities shall be monitored and inspected (see Sections 250.43-9 and 250.43-7) for the purpose of detecting any potential discharge to groundwater, surface water, and air.

(c) Each storage area shall have a continuous base which is impervious to the material being stored, such that any run-off and spills can be contained until the spilled waste can be removed.

(d) Hazardous waste which would cause the air objective (Section 250.42-3) to be exceeded if it were stored in an open manner, particularly with regard to volatility and toxicity, shall be stored in tanks or other closed containers.

(e) Storage tanks and containers shall be of sturdy and leak-proof construction in order to prevent the release of wastes into the environment.

(f) Storage tanks and containers shall be constructed of materials which are compatible with the wastes to be contained, or shall be protected by a liner compatible with the wastes, such that the tank's ability to contain the wastes is not impaired.

(g) A hazardous waste shall not be added to an unwashed storage tank or container that previously held an incompatible material (See Annex 4).

(h) The identity and location of all stored waste shall be known (e.g., via labeling) throughout the entire storage period.

250.44-1 Storage Tanks

(a) Storage tanks which

(1) contain waste with a true vapor pressure greater than 78 mm Hg at 25 C, and

(2) have a storage capacity in excess of 19,000 liters (5,000 gallons)

shall not be vented directly to the atmosphere.

(b) All facilities which store wastes in tanks above ground shall have a spill confinement structure(s) (e.g., dike or trench), the capacity of which is equal to the entire contents of the largest enclosed tank, plus sufficient freeboard to allow for collection and containment of precipitation.

(c) Diking requirements and operational procedures for storage tanks shall be in accordance with EPA's oil and hazardous substances pollution prevention regulations issued pursuant to Section 311 of the FWPCA.

250.44-2 Storage Containers

(a) If containers are not in good condition when received, or if a container's contents begin to leak, the hazardous waste shall be recontainerized.

(b) Containers holding hazardous waste shall not be opened, handled, or stored in a manner which may rupture the containers, or cause them to leak.

(c) All facilities which store wastes in containers shall have a spill confinement structure(s) (e.g., dike or trench), the capacity of which is equal to 10 percent of the containerized waste, plus sufficient freeboard to allow for containment and collection of precipitation.

(d) Storage containers holding wastes which are incompatible shall be separated from each other or protected from each other in order to prevent the wastes from mixing, should the containers break or leak.

(e) Empty combustible containers, e.g., fibrous and paper containers, which previously contained hazardous waste, shall be:

(1) Incinerated in a facility which complies with the requirements of Section 250.45-1.

(2) Buried in a landfill which complies with the requirements of Section 250.45-2.

(f) Empty non-combustible containers, e.g., metal and glass, which previously contained hazardous waste, shall be:

(1) Cleaned by removing hazardous waste residuals at a permitted facility and

(i) transported to a drum reconditioner; or

(ii) transported to a metal recovery facility as scrap for resource recovery; or

(2) Transported to a permitted drum reconditioner, with the appropriate manifest; or

(3) Reused with the same type of waste previously contained, or with another compatible waste provided such reuse is legal under currently applicable U.S. DOT regulations, including those set forth in 49 CFR 173.28.

(g) Paper bags contaminated with hazardous waste shall be stored in closed secondary containers.

250.45 Standards For Treatment/Disposal

(a) Where practical, disposal of hazardous waste shall be avoided and alternatives such as resource recovery, reuse, or other methods of recycling shall be employed.

(b) All facilities which dispose discrete radioactive wastes (as defined in Subpart A) shall be licensed by the U.S. Nuclear Regulatory Commission.

(c) All residuals from treatment operations which are hazardous waste must be handled in accordance with these regulations (40 CFR Part 250). Non-hazardous waste residuals are not subject to regulation under Subtitle C of the Act.

(d) Wastes produced from facilities are subject to the provisions of RCRA, and if hazardous in accordance with Subpart A, shall have to comply with Section 3002 generator standards.

(e) Any hazardous waste which is treated so that it does not have any of the characteristics of a hazardous waste as defined in Subpart A shall not be subject to further regulation under Subtitle C of RCRA. Any used oil hazardous waste which is treated so that it does not have any of the toxicity characteristics of a hazardous waste as defined in Subpart A shall not be subject to further regulation under Subtitle C of RCRA.

250.45-1 Incineration

(a) Owners and operators of hazardous waste incinerators shall conduct trial burns for each hazardous waste which is significantly different than any previously demonstrated under equivalent conditions. The trial burn shall include the following determinations:

(1) An analysis of the hazardous waste for concentrations of halogens and principle hazardous components.

(2) An analysis of the ash residue and scrubber effluent for the principle hazardous components.

(3) An analysis of the exhaust gas for the concentrations of the principle hazardous components, hydrogen halides, CO, CO_2, O_2, total particulates.

(4) An identification of sources of fugitive emissions and their means of control.

(5) A measurement of combustion temperature and computation of residence time.

(6) A computation of combustion efficiency and destruction efficiency.

(7) A computation of scrubber efficiency in removing halogens.

(b) Incinerators used to thermally degrade hazardous waste containing more than 0.5 percent halogens shall be equipped with wet scrubbers capable of removing 99 percent of the halogens from the exhaust gases.

(c) Hazardous waste incinerators which burn pesticide waste or wastes which are hazardous due to their toxicity shall operate at greater than 1000 C combustion zone temperature, greater than two seconds retention time, and greater than two percent excess oxygen during incineration of the hazardous waste.

> NOTE: Incinerators may operate at other conditions if the facility owner/operator can demonstrate that an equivalent degree of destruction will be provided at the other conditions. Pathological incinerators are exempt from the requirements under (c).

(d) Hazardous waste incinerators which burn pesticide waste or wastes which are hazardous due to their toxicity shall be designed, constructed, and operated to maintain a destruction efficiency of 99.99 percent, as defined in the following equation:

$$DE = \frac{W_{in} - W_{out}}{W_{in}} \times 100$$

Where
DE = destruction efficiency

W_{in} = feed rate of principle toxic components of waste going into the incinerator (g/min)

W_{out} = mass emission rate of principle toxic components in waste leaving the incinerator combustion zone (g/min)

NOTE: Pathological incinerators are exempt from the requirements under (d).

(e) Incinerators shall be designed, constructed, and operated such that fugitive emissions of unburned hazardous waste and combustion products are controlled.

(f) Incinerators shall be designed, constructed, and operated to automatically cut off waste feed to the incinerator when significant changes occur in flame, combustion zone temperature, excess air, or scrubber waste pressure.

(g) Incinerators shall continously monitor and record combustion zone temperature and carbon monoxide exhaust gas concentrations.

(h) Incinerators shall be operated at a combustion efficiency equal to or greater than 99.9 percent as defined in the following equation:

$$CE = \frac{C_{CO_2}}{C_{CO_2} + C_{CO}} \times 100$$

Where

CE = combustion efficiency

C_{co2} = concentration of CO_2 in exhaust gas

C_{co} = concentration of CO in exhaust gas

(i) Hazardous waste incinerators shall be operated in a manner that assures that emissions of particulate matter do not exceed 270 milligrams per dry standard cubic meter (0.12 grains per dry standard cubic foot) at zero excess air. Compliance with this requirement may be achieved by having particulate emissions which, when corrected to 12 percent CO_2 by the formula below, are less than 180 milligrams per standard cubic meter (0.08 grains per dry standard cubic foot).

Where

$$PE_c + PE_m \times \frac{Cs}{Cm \times 1.5}$$

PE_c = corrected particulate emissions, mg/m^3 (gr/ft^3)

PE_m = measured particulate emissions, mg/m^3 (gr/ft^3)

C_s = stoichiometric CO_2 concentration, ppm

C_m = measured CO_2 concentration, ppm

250.45-2 Landfills

a) Site Selection

(1) Landfills shall be located or designed, constructed, and operated to prevent direct contact between the landfill and navigable water.

(2) Landfills which have the potential for discharge to an underground drinking water source shall be located or designed

and constructed such that the distance from the bottom of any liner system or natural in-place soil barrier to the average high mean water table is at least 1.5 meters (5 feet).

NOTE: The bottom of any liner system or natural in-place soil barrier may be located less than 1.5 meters (5 feet) above the historical mean water table provided the facility owner/operator can demonstrate that no direct contact will occur between the landfill and the water table.

(3) Active portions of landfills shall be at least 150 meters (500 feet) from any functioning public or private water supply, or livestock water supply.

NOTE: Facilities may locate the active portion of their landfills less than 150 meters from any functioning public or private water supply, or livestock water supply provided that they can demonstrate that the groundwater human health and environmental standard (250.42-1) and the surface water human health and environmental standard (250.42-2) will not be violated.

b) Construction and Operation

(1) Landfills shall be located, designed, constructed, and operated to prevent erosion, landslides, or slumping.

(2) Each landfill shall be located, designed, constructed, and operated such that the liner or natural in-place soil barrier is compatible with the wastes to be landfilled.

(3) The exact location of each waste and the dimensions of each cell with respect to permanently surveyed bench-marks shall be recorded. The contents of each cell shall also be recorded. These records shall be handled as specified in 250.43-6.

(4) Wastes, containerized or non-containerized, that are incompatible (Annex 4) shall be disposed of in separate landfill cells.

(5) The following wastes shall not be disposed at hazardous waste landfills:

(i) reactive wastes, as defined in Subpart A;

(ii) ignitable wastes, i.e., those having a flash point of less than 60 C (140 F);

(iii) wastes with a vapor pressure greater than 78 mm of Hg at 25 C;

(iv) bulk liquids and sludges with a total solids concentration of less than 20 percent.

NOTE: Bulk liquids and sludges with a total solids content of less than 20 percent, may be disposed of at a hazardous waste landfill provided the liquids and sludges are pretreated prior to landfilling or treated in the landfill to reduce their liquid content or increase their solids content to greater than 20 percent.

(6) Diversion structures (e.g., dikes, drainage ditches, etc.) shall be constructed such that surface water runoff be prevented from entering the landfill site.

NOTE: Diversion structures may not be necessary provided the owner/operator can demonstrate that the landfill site is located such that the local topography will prevent surface water runoff from entering the site.

(7) Surface water over active portions (those areas where hazardous wastes are present, according to 250.41-2) of a landfill shall be collected, removed and (1) analyzed to determine if it is a hazardous waste or (2) considered to be a hazardous waste and handled as such.

NOTE: Water collected and removed from active portions need not be analyzed or considered to be a hazardous waste provided the owner/operator can demonstrate that the water could not have been contaminated or if the water is collected and discharged in accordance with NPDES requirements.

(8) Where gases are generated, a gas collection and control system(s) shall be installed to control the vertical and horizontal escape of gases from hazardous waste landfills.

NOTE: Gas collection and control system(s) shall not be required provided the owner/operator can demonstrate that gases will not be generated in the landfill, or that gases generated will not violate the air human health and environmental standard and will not create a flammable or explosive atmosphere.

(9) A minimum of 0.15 meters (6 inches) of cover material shall be applied daily on active hazardous waste landfill cells. Cells which will not have additional wastes placed on them for at least one week shall be covered with 0.30 meters (12 inches) of cover material.

NOTE: Facility owners/operators may use covers of different thicknesses and/or apply them at different frequencies provided they can demonstrate that the possibility of fire or explosion; harboring feeding and breeding of vectors; or violations of the air human health and environmental standard is controlled to an equivalent degree.

(10) Where natural geologic and climatic conditions (evaporation exceeds precipitation) allow, the following design shall be used for the construction and operation of the landfill: along the bottom and internal sides of the landfill at least 3 meters (10 feet) of natural in-place soil with a permeability of less than or equal to 1 x 10-7 cm/sec. and, which meets the criteria of 250.45-2 (b)(13) shall be used.

NOTE: Landfill designs using natural in-place soils of different thicknesses and permeabilities may be used, provided they have a thickness greater than or equal to 1.5 meters (5 feet), and that the facility owner/operator can demonstrate that they will provide equivalent containment of waste.

(11) Facility owner/operators using the design in (b)(10) or any similar design without leachate collection shall demonstrate that liquids will not accumulate in the landfill to the extent they may be discharged to the surface in any manner or to the groundwater in a manner that violates the groundwater human health and environmental standard (250.42-1).

(12) Where natural and climatic conditions do not allow use of the design in (b)(10), one of the following designs shall be used for the construction and operation of the landfill:

Design I

(i) The landfill shall be constructed and operated such that any leachate formed can be contained and removed from the landfill.

(ii) The landfill liner shall meet the criteria specified in (b)(13), be at least 1.5 meters (5 feet) thick, cover the entire bottom and internal sides of the landfill, be constructed of material with a permeability of less than or equal to 1 x 10-7 cm/sec., and be compatible with the waste to be landfilled.

(iii) The liner shall be sloped at a 1 percent minimum grade such that the leachate is drained directly by gravity to a collection sump(s).

(iv) There shall be a permeable layer on top of the bottom liner so that any generated leachate can move rapidly to the collection sump.

(v) The leachate collection system shall be checked at least monthly for the generation of leachate and shall be removed so that a hydraulic head is not created. The leachate shall be considered a hazardous waste unless determined otherwise.

Design II

(i) The landfills shall be constructed and operated such that any leachate formed can be contained and removed from the landfill.

(ii) The design shall consist of a top leachate collection system, a soil liner, a synthetic liner and a bottom leachate collection/detection system. Both liners shall cover the entire bottom and internal sides of the landfill.

(iii) The base of the landfill shall be sloped at a 1 percent minimum grade to direct leachate to a collection sump(s). On the landfill base, there shall be a permeable layer so that any leachate generated can move rapidly to a collection sump(s).

(iv) The synthetic liner shall meet the criteria in (b)(14) and shall be protected on the top and the bottom by a layer of selected clean sand or earth, not less than 14 cm (6 in.) thick, and compatible with the wastes to be landfilled.

(v) The soil liner shall meet the criteria in (13) and shall be at least 1 meter (3 feet) thick and have a permeability of less than or equal to 1 x 10-7 cm/sec. The soil liner shall be sloped at a minimum of 1 percent grade to direct leachate to a collection sump(s).

(vi) On top of the soil liner, there shall be a permeable layer, so that any leachate generated can move rapidly to the collection sump(s).

(vii) The leachate collection systems shall be checked at least monthly for the generation of leachate, and shall be removed so that a hydraulic head is not created. The leachate shall be considered a hazardous waste unless determined otherwise.

NOTE: Facilities may use a landfill design other than the two described above provided the facility owner/operator can demonstrate that the design includes a leachate collection system(s) and provides equivalent waste containment.

(13) Soil liners and natural impermeable barriers shall meet the following minimum criteria:

(i) soils classified under the unified soil classification system CL, CH, and OH (ASTM Standard D2487-69),

(ii) percent passing no. 200 sieve, 30 (ASTM Test D1140),

(iii) liquid limit 30 units (ASTM, Test D423),

(iv) plasticity under 15 units (ASTM Test D424),

(v) pH of 7.0 or higher (Annex 5), and

(vi) permeability not adversely affected by anticipated waste

NOTE: Soil not meeting the above criteria may be used provided the facility owner/operator can demonstrate that such soil will provide equivalent structural stability, waste containment, and will not be adversely affected by the anticipated waste.

(14) Synthetic (artificial) liners shall meet the following minimum criteria:

(i) be of a material that will withstand the chemical, physical, biological and climatic stresses anticipated in the landfill;

(ii) have a minimum thickness of 20 mils;

(iii) have a permeability less than or equal to 1 x 10^{-12} cm/sec;

(iv) have adequate tensile strength to elongate and withstand the stress of installation or use of machinery or equipment;

(v) be of uniform thickness, free from thin spots, cracks, tears, blisters, and foreign particles;

(vi) be placed on a stable base;

(vii) be compatible with the wastes to be landfilled.

(15) All hazardous waste landfills overlying underground drinking water sources shall have groundwater monitoring systems as specified in 250.43-9.

(c) Closure

(1) Final cover shall be provided and consist of at least 15 meters (6 inches) of clay soil with a permeability less than or equal to 1 x 10^{-7} cm/sec., under a minimum cover of 45 cm (18 in.) of soil capable of supporting indigenous vegetation. The top 15 cm (6 inches) of this cover shall be topsoil.

NOTE: Final cover designs using different thicknesses and permeabilities may be used provided the facility owner/operator can demonstrate that they will provide equivalent prevention of infiltration of water, control of sublimination or evaporation of harmful pollutants into the air, and erosion prevention. The facility owner/operator must also demonstrate that the final cover will support vegetation and provide an aesthetically acceptable finished site.

(2) Where trees or other deep-rooted vegetation are to be planted on the completed fill, the cover shall be at least 1 meter (3 feet) of compacted soil which will support the intended deep rooted vegetation.

NOTE: Soil thickness for deep-rooted vegetation may be less than 1 meter (3 feet) provided the facility owner/operator can demonstrate that the roots of the vegetation will not penetrate the 6 inch clay cover.

(3) The final grade shall not exceed 33 percent. Where final grades exceed 15 percent, they shall have at least one horizontal terrace 3 meters (10 feet) or more in width constructed on the slope for each 6.5 meter (20 feet) rise in elevation of the slope. The gradient of the terrace shall be 1-15 percent.

NOTE: The final grade may be of different design and slope provided the facility owner/operator can demonstrate that water will not pool over the landfill and that erosion will be prevented.

(d) Post-Closure

(4) During post-closure care, which shall continue at the facility for a period not to exceed 20 years (see 250.43-8), the following minimum maintainance shall be conducted:

(i) soil integrity, slope, vegetative cover, diversion and drainage structures shall be maintained,

(ii) samples shall be collected from monitoring wells and leachate collection/detection systems annually and analyzed comprehensively as specified in 250.43-9(c) (7),

(iii) survey bench marks shall be maintained.

NOTE: The facility owner/operator may request that the Regional Administrator conduct a hearing to determine which post-closure operations, if any, may be discontinued earlier than 20 years after closure. The facility owner/operator shall bring forth evidence that such post-closure care need not continue.

(iv) Access to the facility shall be restricted in accordance with its intended use.

(5) No buildings shall be constructed over landfills where radioactive wastes as defined in Subpart A have been disposed.

250.45-3 Surface Impoundments

(a) Site Selection

(1) Surface impoundments shall be located or designed, constructed and operated to prevent direct contact between the surface impoundment and navigable water.

(2) Surface impoundments which have the potential to discharge to an underground drinking water source shall be located or designed and constructed such that the bottom of any liner system or natural in-place soil barrier is at least 1.5 m (5 feet) above the historical mean level of the water table.

NOTE: The bottom of any liner system or natural in-place soil barrier may be located less than 1.5 m (5 feet) above the historical mean water table, provided the facility owner/operator can demonstrate that no direct contact will occur between the impoundment and the water table.

(3) Surface impoundments shall be at least 140 m (500 feet) from any functioning public or private water supply or livestock water supply.

NOTE: Surface impoundments may be located less than 150 m (500 feet) from any functioning public or private water supply, or livestock water supply provided the facility owner/operator can demonstrate that the groundwater human health and environmental standard (250.42-1), and the surface water human health and environmental standard (250.42-2) will not be violated.

(4) Surface impoundments shall be located or designed, constructed and operated, to prevent landslides, slumping, and erosion.

(b) Wastes Suitable for Surface Impoundments

(1) Surface impoundments shall not be used to contain waste which is:

(i) detrimental to materials being used as barriers to the waste movement from the impoundment;

(ii) highly reactive, as defined in Subpart A;

(iii) explosive;

(iv) ignitable, i.e., those having a flash point less than 60 C; or

(v) volatile, i.e., those having a vapor pressure greater than 78 mm Hg at 25 C.

(2) The hazardous wastes which contain incompatible chemical groups, as listed in Annex 4, shall not be mixed together in impoundments.

NOTE: Potentially incompatible wastes may be mixed in surface impoundments for the purpose of treatment (i.e., neutralization, precipitation of metal hydroxides, etc.), provided the owner/operator can demonstrate that the wastes will be handled in such a manner as to serve its intended purpose without violating groundwater (250.42-1), surface water (250.42-2), and air (250.42-3) human health and environmental standards.

(3) All hazardous wastes shall be tested prior to disposition in a surface impoundment to determine whether they will have any detrimental effect (e.g., causing cracks, dissolution, decreasing mechanical strength, increasing permeability) on the soils or lining materials used to prevent leakages from the surface impoundment.

(c) Design and Construction

(1) Surface impoundments shall be designed and constructed so as to be capable of preventing discharges to the groundwater and navigable water.

NOTE: Surface impoundments may have such discharges, provided that the facility owner/operator can demonstrate that the discharges will not cause the groundwater (250.42-1), and surface water (250.420-2) human health and environmental standards to be violated.

(2) Where natural soil conditions allow, the following design shall be used for surface impoundments which have the potential for the discharge to an underground drinking water source There shall be along the bottom and sides of the surface impoundment at least 3 m (10 feet) of natural, in-place soil which meets the criteria in (c)(4). Leachate monitoring to detect any discharge shall be conducted as specified in 250.43-9(b).

NOTE: Facility owners/operators may use natural in-place soil barriers of different thicknesses and different permeabilities if they can demonstrate that equivalent waste containment is achieved. However, under no circumstances shall the thickness be less than 1.5 m (5 feet) or be of a permeability greater than 10^{-7} cm/sec.

(3) For surface impoundments which have the potential to discharge to an underground drinking water source and where natural soil conditions do not allow use of the design in (c)(2), the following design shall be used: a top liner, bottom liner, and a leachate detection system. The top liner shall be constructed of specific reconstituted natural clays which meet the criteria in (c)(4), or artificial liners which meet the criteria in (c)(5). The bottom liner shall be constructed of natural in-place soils, or specific or reconstituted natural clays which meet the criteria in (c)(4), and are at least 1.5 m (5 feet) thick, or artificial liners which meet criteria in (c)(5). If an artificial bottom liner is used, wastes shall be removed upon closure of the surface impoundment. The leachate detection system shall be a gravity flow drainage system installed between the top and bottom liners, and shall be capable of detecting any top liner failure. Provisions shall be made for pumping out the leachate in the event of liner failure and for removal of noxious gases from the system.

NOTE: Facility owners/operators may use different designs if they can demonstrate that equivalent waste containment is achieved.

(4) Those soils classified under the Unified Soil Classification System as CL, CH, and OH, (ASTM Standard D2487-69), which meet the following minimum criteria, shall be used as liners or barriers to the passage of wastes or leachate:

(i) Percent soil passing No. 200 sieve 30 ASTM Test D1140,

(ii) Liquid limit 30, (ASTM Test D423),

(iii) Plasticity index 15, (ASTM Test D424),

(iv) pH of 7.0 or higher, (Annex 5),

(v) Permeability of 10^{-7} cm/sec, (ASTM Test D2434),

(vi) Permeability not adversely affected by the anticipated wastes.

NOTE: Soil not meeting the above criteria may be used provided that the facility owner/operator can demonstrate that such soil will provide equivalent structural stability, waste containment, and will not be adversely affected by the anticipated wastes.

(5) Artificial liners (concrete, plastic, etc.) shall:

(i) be of adequate strength and thickness to insure mechanical integrity and have a minimum thickness of 30 mils;

(ii) be compatible with the anticipated waste;

(iii) have a permeability less than or equal to 10^{-7} cm/sec.;

(iv) have an expected service life 25 percent longer than the expected time of facility usage, or comply with usage specified in the landfill section;

(v) be placed on a stable base;

(vi) satisfactorily resist attack from ozone, ultraviolet rays, soil bacteria, and fungus;

(vii) have ample weather resistance to withstand the stress of freezing and thawing;

(viii) have adequate tensile strength to elongate sufficiently and withstand the stress of installation or use of machinery or equipment;

(ix) resist laceration, abrasion and puncture from any matter that may be contained in the fluids it will hold;

(x) be of uniform thickness, free of thin spots, cracks, tears, blisters, and foreign particles;

(xi) be easily repaired.

(6) All artificial liners in surface impoundments using mechanical equipment for operation (e.g., sludge dredging, and collecting, etc.) shall have a protection cover of selected clean earth material (not less than 45 cm (18 inches)) placed directly upon the liner to prevent its rupture.

(7) All surface impoundments which have the potential to discharge to an underground drinking water source shall have groundwater monitoring systems (see 250.43-9).

(8) All surface impoundment dikes shall be designed and constructed in a manner that will preclude discharge of wastes from the facility, both horizontally and vertically.

> NOTE: Surface impoundments may have discharges, provided that the facility owner/operator can demonstrate that the discharges will not cause the groundwater (250.42-1) or surface water (250.42-2) human health and environmental standards to be violated.

(9) All earthen dikes at the facility shall be constructed of a clay-rich soil with a permeability less than or equal to 1 x 10^{-7} cm/sec.

(10) All earthen dikes shall have an outside protective cover (e.g., grass, shale, rock, etc.) to minimize erosion by wind and water.

(d) Operation and Maintenance

(1) Surface impoundments shall be operated and maintained such that discharges to the groundwater, navigable water and ambient air do not occur.

> NOTE: Surface impoundments may have discharges, provided that the facility owner/operator can demonstrate that the discharges will not cause the groundwater (250.42-1),

surface water (250.42-2), and air (250.42-3) human health and environmental standards to be violated.

(2) The freeboard maintained in surface impoundments shall be adequate to contain rainfall from a 4-hour, 25-year storm, but shall be no less than 60 cm (2 feet).

(3) Records shall be kept of the contents and location of each surface impoundment. These records shall be handled as specified in 250.43-6.

(4) The integrity of natural in-place soil barriers or the liners installed in surface impoundments shall be maintained until the closure of the impoundment. Surface impoundment liners or in-place soil barriers shall be repaired immediately upon detection of any failure which could result in contamination of a UDWS or navigable water.

(5) Surface impoundments dikes shall be inspected daily, (as specified under 250.43-7), for the purpose of detecting and correcting any deterioration. Any maintenance or corrective action necessary to restore the dike to its original condition shall be accomplished expeditiously.

(6) Any system provided for the detection of liner failure, or failure of natural in-place soil barriers, shall be inspected daily (see 250.43-7) to insure that it is operating properly for the purpose intended.

(7) Upon final closure, all hazardous waste and hazardous waste residuals shall be removed from surface impoundments which do not meet the criteria for landfills as specified in 250.45-2 and disposed of as required in Subparts B, C, and D. Those surface impoundments which meet the criteria for landfills shall either remove all waste and dispose of them as required in Subparts B, C, and D, or treat the waste to render their solids contents to greater than 20 percent, and close according to the requirements for landfills as specified in 250.45-2. Additionally, the post-closure and financial requirements for landfills apply.

(8) Emptied surface impoundments shall be filled in and seeded with a suitable grass or ground cover crop.

250.45-4 Basins

(1) Basins shall be constructed of impermeable materials of sufficient strength and thickness to ensure mechanical integrity and to prevent the discharge of wastes to navigable water or groundwater.

NOTE: Basins may have discharges, provided that the facility owner/operator can demonstrate that the discharge will not cause the groundwater (250.42-1) and surface water (250.42-2) human health and environmental standards to be violated.

(2) Basins shall not be used to contain waste which is:

a) detrimental to the basins' construction materials;

b) highly reactive, as defined in Subpart A;

c) explosive;

d) ignitable, i.e., those having a flash point less than 60 C;

e) volatile; i.e., those having a vapor pressure greater than 78 mm Hg at 25 C;

(3) Hazardous wastes which contain incompatible chemical groups, as listed in Annex 4, shall not be mixed together in basins.

NOTE: Potentially incompatible wastes may be mixed in basins for the purpose of treatment (i.e., neutralization, precipitation of metal hydroxides, etc.), providing the owner/operator can demonstrate that the wastes will be handled in such a manner as to serve its intended purpose without violating groundwater (250.42-1), surface water (250.42-2), and air (250.42-3) human health and environmental standards.

(4) All hazardous wastes shall be tested prior to disposition in a basin to determine whether it will have any detrimental effect (e.g., causing dissolution, corrosion, increased permeability, decreased mechanical strength) on materials used construction of such basins.

(5) The materials used for construction of basins shall be compatible with hazardous wastes and treatment chemicals under

expected operating conditions (i.e., temperature, pressure, etc.), or shall be protected by a liner compatible with such waste or treatment conditions.

(6) Basins shall be monitored or inspected daily for leaks, corrosion, cracks or other damages. Any damage detected shall be repaired immediately.

(7) All basins which have the potential for discharge to underground drinking water sources shall have groundwater monitoring systems (see 250.43-9).

> NOTE: Basins do not have to have groundwater monitoring systems if the facility owner/operator can demonstrate that a leak could be detected bv visual inspection or other means.

(8) Upon final closure, all hazardous waste and hazardous waste residues shall be removed from basins and disposed of as required in Subpart B, C, and D.

250.45-5 Landfarms

(a) Wastes not amenable to landfarming

(1) The following wastes shall not be landfarmed:

(i) wastes containing arsenic, boron, molybdenum and/or selenium in concentrations greater than soil background conditions (reference 250.45-5(f)(1));

NOTE: Wastes containing arsenic, boron, molybdenum and/or selenium in concentrations greater than soil background conditions may be landfarmed provided the facility owner/operator can demonstrate that the above constituents will not migrate a distance that exceeds three times the depth of the zone of incorporation.

(ii) volatile wastes with a vapor pressure greater than 78 mm Hg at 25 C;

NOTE: Volatile wastes with a vapor pressure greater than 78 mm Hg at 25 C may be landfarmed provided the facility owner/operator can demonstrate that the air human health and environmental standard (250.42-3) will not be violated.

(iii) waste explosives;

(iv) ignitable wastes with a flashpoint less than 60°C.

(b) Incompatible wastes

(1) Landfarms shall be constructed and operated such that potentially incompatible wastes (Annex 4) do not come in contact with one another.

(c) Site Selection

(1) Landfarms shall be located, designed, constructed and operated, to prevent direct contact between the treated area and navigable water.

(2) Landfarms shall be located, designed, constructed and operated, to prevent erosion, landslides, and slumping in the treated area.

(3) Landfarms which have a potential to discharge to underground drinking water sources shall be located or designed, constructed and operated, such that the treated area is at least 1.5m (5 feet) above the historical mean water table.

NOTE: The treated area may be located less than 1.5m (5 feet) above the historical mean water table provided the facility owner/operator can demonstrate that no direct contact will occur between the treated area and the water table.

(4) The treated area of a landfarm shall be at least 150m (500 feet) from any functioning public or private water supply or livestock water supply.

NOTE: The treated area of a landfarm may be located less than 150m (500 feet) from any functioning public or private water supply or livestock water supply provided the facility owner/operator can demonstrate that the groundwater human health and environmental standard (250.42-1) and surface water human health and environmental standard (250.42-2) will not be violated.

(5) Landfarms shall be located in areas with fine grained soils (i.e., more than half the soil constituents are less than 73 microns in size) of the following types, as defined by the Unifed Soil Classification System (ASTM Standard D-2487-69):

OH - organic clays of medium to high plasticity;

CH - inorganic clays of high plasticity, fat clays;

MH - inorganic silts micaceous or diatomaceous fine sandy or silty soils, elastic silts;

CL - inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays;

OL - organic silts and organic silt-clays of low plasticity.

NOTE: Landfarms may be located in areas with soil types other than those specified above provided the facility owner/operator can demonstrate that the alternative soil types will prevent hazardous constituents from vertically migrating a distance that exceeds three times the depth of the zone of incorporation.

(6) Soil types listed in (c)(5) shall have the following characteristics:

(i) liquid limit greater than 30, (ASTM test D423);

(ii) plasticity index greater than 15, (ASTM test D424);

NOTE: Soil types listed in (c)(5) may have a liquid limit less than 30 and/or a plasticity index less than 15 provided the facility owner/operator can demonstrate that the alternative soil types will prevent hazardous constituents from vertically migrating a distance that exceeds three times the depth of the zone of incorporation.

(d) Site preparation

(1) Surface slope of landfarms shall be less than 5 percent to prevent erosion in the treated area by wastes or surface run-off, but greater than 0 percent to prevent wastes or water from ponding or standing for periods that will cause the treated area to become anaerobic.

NOTE: Surface slope of the landfarm may be greater than 5 percent provided the facility owner/operator can demonstrate that it will not cause erosion in the treated area.

(2) Caves, wells (other than active monitoring wells) and other direct connections to the subsurface environment within the treated area of a landfarm or 30m (100 feet) thereof, shall be sealed.

(3) Soil pH in the zone of incorporation shall be equal to or greater than 6.5 (see Annex 5).

NOTE: Soil pH in the zone of incorporation may be less than 6.5 provided the facility owner/operator can demonstrate that hazardous constituents, especially heavy metals, will not vertically migrate a distance that exceeds three times the depth of the zone of incorporation.

(e) Waste application and incorporation

(1) Waste application and incorporation practices shall prevent the zone of incorporation from becoming anaerobic.

(2) Wastes shall not be applied to the soil when it is saturated with water.

> NOTE: Wastes may be applied to the soil when it is saturated with water provided the facility owner/operator can demonstrate that the soil waste mixture will remain aerobic.

(3) Waste shall not be applied to the soil when the soil temperature is 0 C or less.

(4) The pH of the soil-waste mixture in the zone of incorporation shall be equal to or greater than 6.5, and maintained until the time of facility closure.

> NOTE: The pH of the soil-waste mixture in the zone of incorporation may be less than 6.5 provided the facility owner/operator can demonstrate that hazardous constituents, especially heavy metals, will not vertically migrate a distance that exceeds three times the depth of the zone of incorporation.

(5) Supplemental nitrogen and phosphorous added to the soil of the treated area for the purpose of increasing the rate of waste biodegradation shall not exceed the rates of application recommended for agricultural purposes by the USDA, or the appropriate State Department of Agriculture or Agricultural Extension Service.

(f) Soil monitoring

(1) Background soil conditions shall be determined by taking one soil core per acre. The length of the soil core shall be three times the depth of the zone of incorporation or 30 cm, whichever is greater. The bottom one-third of the soil core shall be analyzed for those hazardous constituents in the waste. At new facilities, soil core shall be taken and analyzed prior to beginning operation. At existing facilities, background soil cores shall be taken and analyzed within six months after the effective date of these regulations.

(2) Soil conditions in the treated area of a landfarm shall be determined by taking one soil core per acre semi-annually. The length of the soil core shall be three times the depth of the zone of incorporation or 30 cm, whichever is greater. The bottom one-third of the soil core shall be analyzed for those hazardous constituents known to be in the waste. There shall be no statistically significant increase (i.e., as determined by the Student's t single-tailed test at the 95 percent confidence level), above background soil conditions, of hazardous constituents in the bottom one-third of the soil core.

NOTE: Soil monitoring may be conducted by taking less than one soil core per acre provided the facility owner/operator can demonstrate that hazardous constituents, especially heavy metals, will be detected before vertically migrating a distance that exceeds three times the depth of the zone of incorporation.

(3) If soil monitoring shows that the concentration of a chemical species has increased above background levels in the bottom one-third of the soil core and the increase is statistically significant (i.e., as determined by the Student's t single-tailed test at the 95 percent confidence level), the facility owner/operator shall:

(i) notify the Regional Administrator within seven (7) days;

(ii) determine the cause of the increase, e.g., a design failure, an improper operating procedure, etc.;

(iii) determine the extent of migration of the contaminants in the soil.

(g) Growth of food chain crops

(1) Food chain crops shall not be grown on the treated area of a landfarm.

NOTE: Food chain crops may be grown on the treated area of a landfarm provided the facility owner/operator can demonstrate:

(1) that the practice shall not result in the human consumption of:

(i) arsenic, lead, or mercury;

(ii) food additives banned by the U.S. Food and Drug Administration;

(iii) substances listed in Section 250.13 (a)(4) of Subpart A.

(2) compliance with Subtitle D, Section 257.3-5 (a)(1) and (2), application to land used for the production of food chain crops.

(h) Closure

(1) Landfarms shall be designed and operated such that by the time of closure, food chain crops can be grown on the treated area such that Standard 250.45-5(g), on human consumption, shall not be violated.

250.45-6 Chemical, Physical and Biological Treatment Facilities

(a) Facilities shall be designed, constructed, operated and maintained so as to serve their intended purpose without violating groundwater (250.42-1), surface water (250.42-2), and air (250.42-3) human health and environmental standards.

(b) The materials used in construction of the treatment unit shall be compatible with the hazardous waste and treatment chemicals or reagents under expected operating conditions (e.g., temperature, pressure, etc.).

(c) All hazardous wastes shall be analyzed prior to selection of a treatment technique to determine:

(i) the proper feed rates of treatment chemicals or reagents;

(ii) the proper operating conditions (e.g., temperature, pressure, flow rate, etc.);

(iii) if the waste or reagents will have any detrimental effect (e.g., causing corrosion problems, dissolution, saltings or scalings etc.) on the materials used for construction;

(iv) if the waste contains any components or contaminants which may interfere with the intended treatment process (e.g., biological treatment, solidification, adsorption process etc.) or decrease the effectiveness of the treatment;

(v) if the waste contains components or contaminants which may cause the uncontrolled release of toxic gases or fumes (e.g., H_2S; HCN etc.) during the intended treatment;

(vi) if the waste contains components or contaminants which may form highly toxic components with the treatment chemicals or reagents (e.g., halogenated hydrocarbons, etc.) during the intended treatment.

NOTE: The analyses of hazardous waste may be omitted provided the facility owner/operator can demonstrate that the information provided in the manifest is adequate to satisfy the criteria listed in (i) to (vi) of (c) above, or the facility owner/operator can supply information documenting that the subject hazardous waste is similar to that which has been previously treated at the facility.

(d) Trial tests (bench scale, pilot plant scale, or other appropriate tests) shall be performed for each waste which is new or significantly different than those previously treated to determine treatment technique and operating conditions, and to evaluate the effectiveness of the treatment process and consequences of the proposed treatment.

(e) All treatment chemicals or reagents used in a treatment process shall be stored so as to be in compliance with storage requirements under Section 250.44.

(f) The uncovered reaction vessels shall be sized to provide no less than 60 cm (2 feet) freeboard, to prevent splashings or spillage of hazardous waste during the treatment (e.g., neutralization, precipitation, etc.).

(g) All facilities shall demonstrate the capability to handle the hazardous wastes during facility or equipment breakdown or malfunction. All facilities shall have the capacity for emergency transfer of reactor contents, or emergency storage capacity.

(h) All continuous feed facilities shall be equipped with an automatic waste feed cut-off or a by-pass system which is activated when a malfunction in the treatment process occurs.

(i) Upon final closure, all hazardous waste and hazardous waste residuals shall be removed from chemical, physical and biological treatment facilities and disposed of as required in Subpart D.

(j) Facilities which produce commercial products shall comply with the requirements of Section 250.42-4.

250.45-7 Facilities Which Make Commercial Products From Hazardous Waste

(a) General

(1) The standards in this section define the levels of treatment of a hazardous waste necessary to render it "amenable for recovery." A waste so treated shall not be subject to further regulation under Subtitle C of RCRA.

(2) Any commercial product manufactured from a hazardous waste, whose use constitutes disposal, for which there is no specific commercial product standard shall be treated so as to be rendered nonhazardous.

(3) Product standards promulgated under the Toxic Substances Control Act (TSCA) for any products regulated in this section shall supercede the standards in this section.

(b) Fuel Oil

(1) Fuel oil made from hazardous waste shall contain less than 8 ppm of lead.

(c) Soil Conditioning Products

(1) Soil conditioning products made from hazardous waste shall not contain amounts of substances that, when applied at rates recommended by the manufacturer, will cause the substance addition rates to be exceeded.

Substance Addition Rates (in kg/ha/yr):

Arsenic	1.34
Cadmium	0.08
Lead	0.03

NOTE: Soil conditioning products made from hazardous waste may contain amounts of substances that, when applied at rates recommended by the manufacturer, will cause the substance addition rates to be exceeded, provided that the facility owner/operator applies labels to packaged products and supplies the recipients of bulk products with pamphlets or similar literature that shall:

(1) state that the product is made from hazardous waste and shall not be applied to food chain crops, and,

(2) list the levels of arsenic, cadmium, and lead in mg/kg on a dry weight basis.

(d) Chlorinated Cement Kiln Fuel

(Space reserved)

250.46 SPECIAL WASTE STANDARDS

250.46-1 Cement Kiln Dusts [Space Reserved]

250.46-2 Utility Wastes [Space Reserved]

250.46-3 Phosphate Rock Mining and Processing [Space Reserved]

250.46-4 Uranium Mining/Milling Waste [Space Reserved]

250.46-5 Other Mining Waste [Space Reserved]

250.46-6 Oil Drilling Muds And Brines [Space Reserved]

ANNEX 1

DRINKING WATER STANDARDS

Parameter	Maximum Level
A. Interim Primary	
	(mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (VI)	0.05
Fluoride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Endrin	0.002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.01
2,4,5-TP Silvex	0.01
Radium	5 pCi/l
Gross Alpha	15 pCi/l
Gross Beta	4 millirem/yr
Turbidity	1 TU
Coliform Bacteria	1/100 ml
B. Secondary	
	(mg/l)
Chloride	250
Copper	1
Foaming Agents	0.5
Hydrogen Sulfide	0.05
Iron	0.3
Manganese	0.05
Sulfate	250
TDS	500
Zinc	5
Color	15 Color Units
Corrosivity	Non-corrosive
Odor	3 Threshold Odor Number
pH	6.5-8.5

ANNEX 2

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

		TWA	
	Substance	ppm	mg/m^3
	Abate	---	10
	Acetaldehyde	100	180
	Acetic acid	10	25
C	Acetic anhydride	5	20
	Acetone	1,000	2,400
	Acetonitrile	40	70
	Acetylene	F	---
	Actylene dichloride, see 1,2-Dichloroethylene	200	790
	Acetylene tetrabromide	1	14
	Acrolein	0.1	0.25
	Acrylamide - Skin	---	0.3
	Acrylonitrile - Skin	20	45
	Aldrin - Skin	---	0.25
	Allyl alcohol - Skin	2	5
	Allyl chloride	1	3
	Allyl glycidyl ether (AGE) - Skin	5	22
	Allyl propyl disulfide	2	12
	Alundum (Al$_2$O$_3$)	---	E
	4-Aminodiphenyl - Skin	---	A1b
	2-Aminoethanol, see Ethanolamine	3	6
	2-Aminopyridine	0.5	2
	Ammonia	25	18
	Ammonium chloride-fume	---	10
	Ammonium sulfamate (Ammate)	---	10
	n-Amyl acetate	100	525
	sec-Amyl acetate	125	650
	Aniline - Skin	5	19
	Anisidine (o-p-isomers) - Skin	0.1	0.5
	Antimony & Compounds as Sb)	---	(0.5)
	ANTU (α-Naphthyl thiourea)	---	0.3
	Argon	F	---
	Arsenic & compounds (as As)	---	(0.5)
	Arsine	0.05	0.2
	Asbestos (all forms)	---	A1a
	Asphalt (petroleum) fumes	---	5
	Azinphos methyl - Skin	---	0.2
	Baygon (propoxur)	---	0.5
	Barium (soluble compounds)	---	0.5
	Benzene - Skin	10,A2	30,A2
	Benzidine production - Skin	---	A1b
	p-Benzoquinone, see Quinone	0.1	0.4
	Benzoyl peroxide	---	5
	Benz(a)pyrene	---	A2
	Benzyl chloride	1	5
	Beryllium	---	0.002
	Biphenyl	0.2	1
	Bismuth telluride	---	10
	Bismuth telluride, Se-doped	---	5
	Borates, tetra, sodium salts,		
	Anhydrous	---	1
	Decahydrate	---	5
	Pentahydrate	---	1
	Boron oxide	---	10
	Boron tribromide	1	10
C	Boron trifluoride	1	3
	Bromine	0.1	0.7
	Bromine pentafluoride	0.1	0.7
	Bromochloromethane	200	1,050
	Bromoform - Skin	0.5	5
	Butadiene (1, 3 butadiene	1,000	2,200
	Butane	600	1,400
	Butanethiol, see Butyl mercaptan	0.5	1.5
	2-Butanone	200	590
	2-Butoxy ethanol (Butyl Cellosolve) - Skin	50	240
	n-Butyl acetate	150	710
	sec-Butyl acetate	200	950
	tert-Butyl acetate	200	950
C	n-Butyl alcohol - Skin	50	150
	sec-Butyl alcohol	150	450
	tert-Butyl alcohol	100	300
C	Butylamine - Skin	5	15
C	tert-Butyl chromate (as CrO$_3$) - Skin	---	0.1
	n-Butyl glycidyl ether (BGE)	50	270
	n-Butyl lactate	5	25
	Butyl mercaptan	0.5	1.5
	p-tert-Butyltoluene	10	60
	Cadmium, dust & salts (as Cd)	---	0.05
C	Cadmium oxide fume (as Cd)	---	0.05
	Calcium carbonate	---	E
	Calcium arsenate (as As)	---	1
	Calcium cyanamide	---	0.5
	Calcium hydroxide	---	5
	Calcium oxide	---	(5)
	Camphor, synthetic	2	12
	Caprolactam		
	Dust	---	1
	Vapor	5	20

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA	
	ppm	mg/m^3
Captafol (Difolatan) - Skin	---	0.1
Captan	---	5
Carbaryl (Sevin)	---	5
Carbofuran (Furadan)	---	0.1
Carbon black	---	3.5
Carbon dioxide	5,000	9,000
Carbon disulfide - Skin	20	60
Carbon monoxide	50	55
Carbon tetrabromide	0.1	1.4
Carbon tetrachloride - Skin	10	65
Catechol (Pyrocatechol)	5	20
Cellulose (paper fiber)	---	E
Cesium hydroxide	---	2
Chlordane - Skin	---	0.5
Chlorinated camphene - Skin	---	0.5
Chlorinated diphenyl oxide	---	0.5
Chlorine	1	3
Chlorine dioxide	0.1	0.3
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
α-Chloroacetophenone (Phenacyl chloride)	0.05	0.3
Chlorobenzene (Monochlorobenzene)	75	350
o-Chlorobenzylidene malonoitrite - Skin	0.05	0.4
Chlorobromomethane	200	1,050
2-Chloro-1,3-butadiene see βChloroprene	25	90
Chlorodifluoromethane	1,000	3,500
Chlorodiphenyl (42% Chlorine) - Skin	---	1
Chlorodiphenyl (54% Chlorine) - Skin	---	0.5
1-Chloro,2, 3-epoxy-propane (Epichlorhydrin)	5	20
2-Chloroethanol (Ethylene chlorohydrin)	1	3
Chloroethylene (Vinyl chloride)	Alc	---
Chloroform (Trichloromethane)	(25)	(120)
bis-Chloromethyl ether	0.001	Ala
1-Chloro-1-nitro-propane	20	100
Chloropicrin	0.1	0.7
β-Chloroprene - Skin	25	90
Chlorpyritos (Dursban) - Skin	---	0.2
o-Chlorostyrene	50	285
o-Chlorotoluene - Skin	50	250
2-Chloro 6-(trichloromethyl pyridine (N-Serve)	---	10
Chromates, certain insoluble forms	---	0.05Ala
Chromic acid and Chromates (as Cr)	---	0.05
Chromium, Sol. chromic, chromous salts (as Cr)	---	0.5
Clopidol (Coyden)	---	10
Coal tar pitch volatiles (see Particulate polycyclic aromatic hydrocarbons)	---	Ala
Cobalt metal, dust and fume	---	(0.1)
Copper fume	---	0.2
Dusts & Mists	---	1
Corundum (Al_2O_3)	---	E
Cotton dust, raw	---	0.2
Crag herbicide	---	10
Cresol, all isomers - Skin	5	22
Crotonaldehyde	2	6
Crufomate	---	5
Cumene - Skin	50	245
Cyanamide	---	2
Cyanide, as CN - Skin	---	5
Cyanogen	10	20
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclohexylamine - Skin	10	40
Cyclopentadiene	75	200
2,4-D (2,4-Diphenoxy-acetic acid)	---	10
DDT (Dichlorodiphenyl trichloroethane)	---	1
DDVP, see Dichlorvos	0.1	1
Decaborane - Skin	0.05	0.3
Demeton - Skin	0.01	0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1,2-Diaminoethane, see Ethylenediamine	10	25
Diazinon - Skin	---	0.1
Diazomethane	0.2	0.4
Diborane	0.1	0.1

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA	
	ppm	mg/m^3
1,2-Dibromoethane (Ethylene dibromode) - Skin	20	145
Dibrom	---	3
2-N-Dihutylaminoethanol - Skin	2	14
Dibutyl phosphate	1	5
Dibutyl phthalate	---	5
C Dichloracetylene	0.1	0.4
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorobenzidine 0 Skin	---	A2
Dichlorodifluoromethane	1,000	4,950
1,3-Dichloro-5 5-dimethyl hydantoin	---	0.2
1,1-Dichloroethane	280	820
1,2-Dichloroethane	50	200
1,2-Dichloroethylene	200	790
Dichloroethyl ether - Skin	5	30
Dichloromethane, see Methylene chloride	200	720
Dichloromonofluoromethane	(1,000)	(1,200)
C 1,1-Dichloro-1-nitroethane	10	60
1,2-Dichloropropane, see Propylene dichloride	75	350
Dichlorotetrafluoroethane	1,000	7,000
Dichlorvos (DDVP) - Skin	0.1	1
Dicrolophos (Bidrin) - Skin	---	0.25
Dicyclopentadiene	5	30
Dicyclopentadienyl iron	---	10
Dieldrin - Skin	---	0.25
Diethylamine	25	75
Diethylaminoethanol - Skin	10	50
Diethylene triamine - Skin	1	4
Diethyl ether, see Ethyl ether	400	1,200
Diethyl phthalate	---	5
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone	---	2
Diisobutyl ketone	25	150
Diisopropylamine - Skin	5	20
Dimethoxymethane, see Methylal	1,000	3,100
Dimethyl acetamide - Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene	5	25
Dimethylaniline (N-Dimethylaniline) - Skin	5	25
Dimethylbenzene, see Xylene	100	435
Dimethyl-1 2-dibromo-2-dichloroethyl phosphate, see Dibrom	---	3
Dimethylformamide - Skin	10	30
2,6-Dimethylheptanone, see Diisobutyl ketone	25	150
1,1-Dimethylhydrazine - Skin	0.5	1
Dimethylphthalate	---	5
C Dimethyl sulfate - Skin	0.5A2	0.5A2
Dinitrobenzene (all isomers) - Skin	0.15	1
Dinitro-o-cresol - Skin	---	0.2
3,5-Dinitro-o-toluamide (Zoalene)	---	5
Dinitrotoluene - Skin	---	1.5
Dioxane, tech grade - Skin	50	180
Dioxathion (Delnav)	---	0.2
Diphenyl, see Biphenyl	0.2	1
Diphenylamine	---	10
Diphenylmethane diisocyanate, see Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Dipropylene glycol methyl ether - Skin	100	600
Diqual	---	0.5
Di-sec. octyl phthalate (Di-2-ethylhexyl-phthalate)	---	5
Disulfuram	---	2
Disyston - Skin	---	0.1
2,6-Ditert. butyl-p-cresol	---	10
Diuron	---	10
Dylonate	---	0.1
Emery	---	E
Endosulfan (Thiodan) - Skin	---	0.1
Endrin - Skin	---	0.1
Epichlorhydrin - Skin	5	20
EPN - Skin	---	0.5

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA	
	ppm	mg/m^3
1,2-Epoxypropane, see Propylene oxide	100	240
2,3-Epoxy-1-propanol, see Glycidol	50	150
Ethane	F	---
Ethanethiol, see Ethyl mercaptan	0.5	1
Ethanolamine	3	6
Ethion (Niatate) - Skin	---	0.4
2-Ethoxyethanol - Skin	100	370
2-Ethoxyethyl acetate (Cellosolve acetate) - Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate - Skin	25	100
Ethyl alcohol (Ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone 1,1-Methyl-3-heptanones	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethylbutyl ketone (3 Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
Ethyl mercaptan	0.5	1
Ethyl silicate	(100)	(850)
Ethylene	F	---
C Ethylene chlorohydrin - Skin	1	3
Ethylene diamine	10	25
Ethylene Dibromide, see 1,2-Dibromoethane	20	145
Ethylene dichloride, see 1,2-Dichloroethane	50	200
Ethylene glycol		
Particulate	---	10
Vapor	100	260
C Ethylene glycol dinitrate and or Nitroglycerin - Skin	0.2	---
Ethylene glycol monomethyl ether acetate (Methyl Cellosolve acetate) - Skin	25	120
Ethylene oxide	50	90
Ethylenimine - Skin	0.5	1
Ethylidene chloride, see 1,1-Dichloroethane	200	320
C Ethylidene norbornene	5	29
N-Ethylmorpholine - Skin	20	94
Fensulforhion (Dasanit)	---	0.1
Ferbam	---	10
Ferrovanadium dust	---	1
Fluoride (as F)	---	2.5
Fluorine	1	2
Fluorotrichloromethane	1,000	5,600
C Formaldehyde	2	3
Formamide	20	30
Formic acid	5	9
Furfural - Skin	5	20
Furfuryl alcohol - Skin	5	20
Gasoline	---	B2
Germanium tetrahydride	0.2	0.6
Glutalaldehyde, activated or unactivated	---	(0.25)
Glycerin mist	---	E
Glycidol (2,3-Epoxy 1-propanol)	50	150
Glycol monoethyl ether sec 2-Ethoxyethanol	100	370
Graphite (Synthetic)	---	E
Guthion - see Azinphos methyl	---	0.2
Gypsum	---	E
Hafnium	---	0.5
Helium	F	---
Heptachlor - Skin	---	0.5
Heptane (n-Heptane)	400	1,600
Hexachlorocyclopentadiene	0.01	0.11
Hexachlorethane - Skin	1	10
Hexachlornaphthalene - Skin	---	0.2
Hexafluoroacetone	0.1	0.7
Hexane (n-hexane)	100	360
2-Hexanone, see Methyl butyl ketone - Skin	25	100
Hexone (Methyl isobutyl ketone) - Skin	100	410
sec-Hexyl acetate	50	300
C Hexylene glycol	25	125
Hydrazine - Skin	0.1	0.1
Hydrogen	F	---
Hydrogenated tephenyls	0.5	5
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide - Skin	10	11
Hydrogen fluoride	3	2
Hydrogen peroxide	1	1.4
Hydrogen selenide	0.05	0.2
Hydrogen sulfide	10	15
Hydroquinone	---	2
Indene	10	45
Indium & Compounds (as In)	---	0.1
C Iodine	0.1	1

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA	
	ppm	mg/m^3
Iodoform	0.2	3
Iron oxide fume	B3	5
Iron pentacarbonyl	0.01	0.08
Iron salts, soluble (as Fe)	---	1
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	50	150
C Isophorone	5	25
Isophorone diisocyanate - Skin	0.01	0.06
Isopropyl acetate	250	950
Isopropyl alcohol - Skin	400	980
Isopropylamine	5	12
Isopropyl ether	250	1,050
Isopropyl glycidyl ether (IGE)	50	240
Kaolin	---	E
Ketene	0.5	0.9
Lead, inorg., fumes & dusts (as Pb)	---	0.15
Lead arsenate (as Pb)	---	0.15
Lead Chromate (as Cr)	---	0.05A2
Limestone	--	E
Lindane - Skin	---	0.5
Lithium hydride	---	0.025
L.P.G. (Liquified petroleum gas)	1,000	1,800
Magnesite	---	E
Magnesium oxide fume	---	10
Malathion - Skin	--	10
Maleic anhydride	0.25	1
C Manganese & Compounds (as Mn)	---	5
Manganese cyclopentadienyl tricarbonyl (as Mn) - Skin	---	0.1
Marble	---	0.1
Mercury (Alkyl compounds) - Skin as Hg	0.001	0.01
Mercury (all forms except alkyl) as Hg	---	0.05
Mesityl oxide	25	100
Methane	F	---
Methanethiol, see Methyl mercaptan	0.5	1
Methomyl (Lannate) - Skin	---	2.5
Methoxychlor	---	10
2-Methoxyethanol - Skin (Methyl cellosolve)	25	80
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate - Skin	10	35
Methyl acrylonitrate - Skin	1	3
Methylal (dimethoxymethane)	1,000	3,000
Methyl alcohol (methanol) - Skin	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol	25	100
Methyl 2-cyanoacrylate	2	8
Methyl isoamyl ketone	100	475
Methyl n-amyl ketone (2-Heptanone)	100	465
Methyl bromide - Skin	15	60
Methyl butyl ketone, see 2-hexanone	25	100
Methyl cellosolve - Skin, see 2-methoxyethanol	25	80
Methyl cellosolve acetate - Skin, see ethylene glycol monomethyl ether acetate	25	120
Methyl chloride	100	210
Methyl chloroform	350	1,900
Methylcyclohexene	400	1,600
Methylcyclohexanol	50	235
o-Methycyclohexanone - Skin	50	230
Methylcyclopentadienyl manganese tricarbonyl (as Mn) - Skin	0.1	0.2
Methyl demeton - Skin	---	0.5
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Methylene chloride (dichloromethane)	200	720
4,4-Methylene bis (2-chloraniline) - Skin	0.02A2	---
C Methylene bis (4-cyclohexyhsocyanate)	0.01	0.11
Methyl ethyl ketone (MEK), see 2-Butanone	200	590

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA ppm	TWA mg/m^3
C Methyl ethyl ketone peroxide	0.2	1.5
Methyl formate	100	250
Methyl iodide - Skin	5	28
Methyl isobutyl carbinol - Skin	25	100
Methyl isobutyl ketone, see Hexone	100	410
Methyl isocyanate - Skin	0.02	0.05
Methyl mercaptan	0.5	1
Methyl methacrylate	100	410
Methyl parathion - Skin	---	0.2
Methyl propyl ketone, see 2-Pentanone	200	700
C Methyl silicate	5	30
C αMethyl styrene	100	480
Molybdenum (as Mo)		
Soluble compounds	---	5
Insoluble compounds	---	10
Monocrotophos (Azodrin)	---	0.25
Monomethyl aniline - Skin	2	9
C Monomethyl hydrazine Skin	0.2	0.35
Morpholine - Skin	20	70
Naphthalene	10	50
β-Naphthylamine	---	A1b
Neon	F	---
Nickel carbonyl	0.05	0.35
Nickel metal	---	1
Nickel soluble compound (as Ni)	---	0.1
Nicotine - Skin	---	0.5
Nitric acid	2	5
Nitric oxide	25	30
p-Nitroaniline - Skin	1	6
Nitrobenzene - Skin	1	5
p-Nitrochlorobenzene - Skin	---	1
4-Nitrodiphenyl	---	A1b
Nitroethane	100	310
C Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
Nitroglycerine - Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
Nitrosodimethylamine (dimethylnitrosomine) - Skin	---	A2
Nitrotoluene - Skin	5	30
Nitrochloromethane, see Chloropicrin)	0.1	0.7
Nonane	200	1,050
Octochloronaphthalene - Skin	---	0.1
Octane	300	1,450
Oil mist	---	5
Osmium tetroxide	0.00002	0.002
Oxalic acid	---	1
Oxygen difluoride	0.05	0.1
Ozone	0.1	0.2
Paraffin wax fume	---	2
Paraquat - Skin	---	(0.5)
Parathion - Skin	---	0.1
Particulate polycyclic aromatic hydrocarbons (PPAH) as benzene solubles	---	0.2A1a
Pentaborane	0.005	0.01
Pentachloronaphthalene	---	0.5
Pentachlorophenol - Skin	---	0.5
Pentaerythritol	---	E
Pentane	600	1,800
2-Pentanone	200	700
Perchloroethylene - Skin	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	14
Petroleum distillates (naptha)	83	---
Phenol - Skin	5	19
Phenothiazine - Skin	---	5
p-Phenylene diamine - Skin	---	0.1
Phenyl ether (vapor)	1	7
Phenyl ether-Diphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene	100	420
Phenyl glycidyl ether (PGE)	10	60
Phenythydrazine - Skin	5	22
C Phenylphosphine	0.05	0.25
Phorate (Thimel) - Skin	---	0.05
Phosdrin (Mevinphos) - Skin	0.01	0.1
Phosgene (carbonyl chloride)	0.10	0.4
Phosphine	0.3	0.4
Phosphoric acid	---	1
Phosphorus (yellow)	---	0.1
Phosphorus pentachloride	---	1
Phosphorus pentasulfide	---	1
Phosphorus trichloride	0.5	3
Phthalic anhydride	1	6
m-Phthalodinitrite	---	5
Pictoram (Tordon)	---	10
Picric acid - Skin	---	0.1
Pival (2-Pivalyl-1, 3-indandione)	---	0.1

ANNEX 2 (Continued)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA ppm	TWA mg/m^3
Plaster of Paris	---	E
Platinum (Soluble salts) as Pt	---	0.002
Polychlorobiphenyls, see Chlorodiphenyls	---	---
Polytetrafluoroethylene decomposition products	---	B1
C Potassium hydroxide	---	2
Propane	F	---
β-Proprotactone	---	A2
Propargyl alcohol - Skin	1	2
n-Propyl acetate	200	810
Propyl alcohol - Skin	200	500
n-Propyl nitrate	25	110
Propylene	F	---
Propylene dichloride (1, 2-Dichloropropane)	75	350
Propylene glycol monomethyl ether	100	360
Propylene imine - Skin	2	5
Propylene oxide	100	240
Propyne, see Methyl-acetylene	1,000	1,650
Pyrethrum	---	5
Pyridine	5	15
Quinone	0.1	0.4
RDX - Skin	---	1.5
Resorcinol	10	45
Rhodium, Metal fume and dusts (as Rh)	---	0.1
Soluble salts	---	0.001
Ronnel	---	10
Rosin core solder pyrolysis products (as formaldehyde)	---	0.1
Rotenone (commercial)	---	5
Rouge	---	E

Substance	TWA ppm	TWA mg/m^3
Rubber solvent	400	1,600
Selenium compounds (as Se)	---	0.2
Selenium hexafluoride (as Se)	0.05	0.4
Sevin, see Carbaryl	---	5
Silane, see Silicon tetrahydride	0.5	7
Silicon	---	E
Silicon carbide	---	E
Silicon tetrahydride (Silane)	0.5	0.7
Silver, metal and soluble compounds, as Ag	---	0.01
C Sodium azide	0.1	0.3
Sodium fluoroacetate (1080) - Skin	---	0.05
C Sodium hydroxide	---	2
Starch	---	E
Stibine	0.1	0.5
Stoddard solvent	100	575
Strychnine	---	0.15
Styrene monomer (Phenylethylene)	100	420
Succinaldehyde, see Glutaraldehyde	---	(0.25)
C Subtilisins (Proteolytic enzymes as 100% pure crystalline enzyme)	---	0.00006
Sucrose	---	E
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	---	1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfur tetrafluoride	0.1	0.4
Sulfuryl fluoride	5	20
Systox, see Demeton	0.01	0.1

Substance	ppm	mg/m^3
2, 4, 5-T	---	10
Tantalum	---	5
TEDP - Skin	---	0.2
Teflon decomposition products	---	B1
Tellurium	---	0.1
Tellurium hexalfluoride, as Te	0.02	0.2
TEPP - Skin	0.004	0.05
C Terphenyls	1	9
1,1,1,2-Tetrachloro-2, 2-difluoroethane	500	
1,1,2,2-Tetrachloro-1, 2-difluoroethane	500	4,170
1,1,2 2-Tetrachloroethane - Skin	5	35
Tetrachloroethylene, see Perchloroethylene	100	670
Tetrachloromethane, see Carbon tetrachloride	10	65
Tetrachloronaphthalene	---	2
Tetraethyl lead (as Pb) - Skin	---	0.100
Tetrahydrofuran	200	590
Tetramethyl lead (as Pb) - Skin	---	0.150
Tetramethyl succinonitrile - Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2,4, 6-trinitrophenyl-methylnitramine) - Skin	---	1.5
Thallium soluble compounds (as Tl) - Skin	---	0.1
4,4-Thiobis (6-tert. butyl-m-cresol)	---	10

ANNEX 2 (Concluded)

THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES*

Substance	TWA ppm	TWA mg/m^3
Thiram	---	5
Tin, inorganic compounds except SnH$_4$ and SnO$_2$ (as Sn)	---	2
Tin organic compounds (as Sn) - Skin	---	0.1
Tin oxide	---	E
Titanium dioxide	---	E
Toluene (toluol) - Skin	100	375
C Toluene-2, 4-diisocyanate (TDI)	0.02	0.14
o-Toluidine	5	22
Toxaphene, see Chlorinated camphene	---	0.5
Tributyl phosphate	---	5
1,1,1-Trichloroethane see Methylchloroform	350	1,900
1,1,2-Trichloroethane - Skin	10	45
Trichloroethylene	100	535
Trichloromethane, see Chloroform	(25)	(120)
Trichloronaphthalene	---	5
1,2,3-Trichloropropane	50	300
1,1,2-Trichloro 1,2, 2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Tricyclohexyltin hydroxide (Plictran)	---	5
Trifluoromonobromo-methane	1,000	6,100
Trimethyl benzene	25	120
2,4,6-Trinitrophenol, see Picric acid	---	0.1
2,4,6-Trinitrophenyl-methylnitramine, see Tetryl	---	1.5
Trinitrotoluene (TNT) - Skin	---	(1.5)
Triorthocresyl phosphate	---	0.1
Triphenyl phosphate	---	3
Tungsten & compounds, as W		
Soluble	---	1
Insoluble	---	5
Turpentine	100	560
Uranium (natural) soluble and insoluble compounds, as U	---	0.2
Vanadium (V$_2$O$_3$), as V		
C Dust	---	0.5
Fume	---	0.05
Vinyl acetate	10	30
Vinyl benezene, see Styrene	100	420
Vinyl bromide	(250)	(1,100)
Vinyl chloride	(200)	(510)
Vinyl cyanide, see Acrylonitrite	20	45
Vinyl cyclohexene dioxide	10	60
Vinylidene chloride	10	40
Vinyl toluene	100	480
Warfarin	---	0.1
Welding fumes (Total particulate)	---	5B3
Wood dust (nonallergenic)	---	5
Xylene (o-m-p-isomers) - Skin	100	435
C m-Xylene	---	0.1
Xylidene - Skin	5	25
Yttrium	---	1
Zinc chloride fume	---	1
Zinc chromate (as Cr)	---	0.05A2
Zinc oxide fume	---	5
Zinc stearate	---	E
Zirconium compounds (as Zr)	---	5

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* Published by the American Conference of Governmental Industrial Hygienists.

ANNEX 3

FORM APPROVED
OMB NO.

TSDF (TREATMENT, STORAGE OR DISPOSAL FACILITIES) REPORT

IDENTIFICATION

NAME

ADDRESS

TSDF IDENTIFICATION CODE

CLOSING DATE

WASTE INFORMATION

GENERATOR I.D. CODE	MANIFEST DOCUMENT NUMBER	SHIPPING DESCRIPTION	QUANTITY	UNIT OF MEASURE

DRAFT

COMMENTS

CERTIFICATION

I certify that the above information is correct to the best of my knowledge and belief.

SIGNATURE

DATE

EPA Form 8700-13 (4-78)

ANNEX 4

INCOMPATIBLE WASTES

Many wastes, when mixed with others at a hazardous waste facility, can potentially produce adverse human health and environmental effects through means such as the following: (1) heat generation, (2) violent reaction, (3) release of toxic fumes and gases as result of mixing, (4) release of toxic substances in case of fire or explosion, (5) fire or explosion, and (6) generation of flammable or toxic gases.

Below is a summary list of potentially incompatible waste materials/waste components and the adverse consequences resulting from mixing of wastes in one group with those in another group.

List of Potentially Incompatible Wastes

The mixing of a Group A waste with a Group B waste may have the potential consequence as noted.

Group 1-A

- Acetylene sludge
- Alkaline caustic liquids
- Alkaline cleaner
- Alkaline corrosive liquids
- Alkaline corrosive battery fluid
- Caustic wastewater
- Lime sludge and other corrosive alkalies
- Lime wastewater
- Lime and water
- Spent caustic

Group 1-B

- Acid sludge
- Acid and water
- Battery acid
- Chemical cleaners
- Electrolyte, acid
- Etching acid liquid or solvent
- Liquid cleaning compounds
- Pickling liquor and other corrosive acids
- Sludge acid
- Spent acid
- Spent mixed acid
- Spent sulfuric acid

Potential consequences: Heat generation, violent reaction.

. . . .

Group 2-A	Group 2-B
Asbestos waste and other toxic wastes	Cleaning solvents
Beryllium wastes	Data processing liquid
Unrinsed pesticide containers	Obsolete explosives
Waste pesticides	Petroleum waste
	Refinery waste
	Retrograde explosives
	Solvents
	Waste oil and other flammable and explosive wastes

Potential consequences: Release of toxic substances in case of fire or explosion.

. . . .

Group 3-A	Group 3-B
Aluminum	Any waste in Group 1-A or 1-B
Beryllium	
Calcium	
Lithium	
Magnesium	
Potassium	
Sodium	
Zinc powder and other reactive metals and metal hydrides	

Potential consequences: Fire or explosion; generation of flammable hydrogen gas.

. . . .

Group 4-A	Group 4-B
Alcohols	Any concentrated waste in Groups 1-A or 1-B
Water	Calcium
	Lithium
	Metal hydrides
	Potassium
	Sodium
	SO_2Cl_2, $SOCl_2$, PCl_3, CH_3SiCl_3, and other water-reactive wastes

Potential consequences: Fire, explosion, or heat generation; generation of flammable or toxic gases.

. . . .

Group 5-A

Alcohols
Aldehydes
Halogenated hydrocarbons
Nitrated hydrocarbons and other reactive organic compounds and solvents
Unsaturated hydrocarbons

Group 5-B

Concentrated Group 1-A or 1-B wastes
Group 3-A wastes

Potential consequences: Fire, explosion or violent reaction.

. . . .

Group 6-A

Spent cyanide and sulfide solutions

Group 6-B

Group 1-B wastes

Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.

. . . .

Group 7-A

Chlorates and other strong oxidizers
Chlorine
Chlorites
Chromic acid
Hypochlorites
Nitrates
Nitric acid, fuming
Perchlorates
Permanganates
Peroxides

Group 7-B

Acetic acid and other organic acids
Concentrated mineral acids
Group 2-B wastes
Group 3-A wastes
Group 5-A wastes and other flammable and combustible wastes

Potential consequences: Fire, explosion, or violent reaction.

. . . .

SOURCE: "Law, regulations and guidelines for handling of hazardous waste," California Department of Health, February 1975.

ANNEX 5

METHODS FOR DETERMINING SOIL pH

A. Method for Soil pH in Water (For Non-Calcareous Soils)

To 20 g. of soil in a 50-ml. beaker, add 20 ml. of distilled water, and stir the suspension several times during the next 30 minutes. Let the soil suspension stand for about 1 hour to allow most of the suspended clay to settle out from the suspension. Adjust the position of the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed well into the partly settled suspension, and the calomel electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Then insert the electrodes into the partly settled suspension as indicated above, measure the pH, and report the results as "soil pH measured in water."

B. Method for Soil pH in 0.01m $CaCl_2$ Solution (For Calcareous Soils)

Reagents

1. Stock calcium chloride solution ($CaCl_2$) 3.6M: Dissolve 1,059 g. of $CaCl_2 \cdot 2H_2O$ in distilled water in a 2-liter volumetric flask. Cool the solution, dilute it to volume with distilled water, and mix it well. Dilute 20 ml. of this solution to 1 liter with distilled water in a volumetric flask, and standardize it by titrating a 25 ml.

aliquot of the diluted solution with standard 0.1N $AgNO_3$, using 1 ml. of 5 percent K_2CrO_4 as the indicator.

2. Calcium chloride ($CaCl_2$) 0.01M: Dilute 50 ml. of stock 3.6M $CaCl_2$ to 18 liters with distilled water. If the pH of this solution is not between 5 and 6.5, adjust the pH by addition of a little $Ca(OH)_2$ or HCL. As a check on the preparation of this solution, measure its electrical conductivity. The specific conductivity should be 2.32 = 0.08 mmho. per cm. at 25°C.

Procedure

To 10 g. of soil in a 50-ml. beaker, add 20 ml. of 0.01M $CaCl_2$ solution, and stir the suspension several times during the next 30 minutes. Let the soil suspension stand for about 30 minutes to allow most of the suspended clay to settle out from the suspension. Adjust the position of the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed well into the partly settled suspension and the calomel electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Then insert the electrodes into the partly settled suspension as indicated above, measure the pH, and report the results as "soil pH measured in 0.01M $CaCl_2$."

Source: "Methods of Soil Analysis." Part II Chemical and Microbiological Properties. C.A. Black, Ed. (American Society of Agronomy, 1965.)

SUBPART E - PERMIT SYSTEM FOR FACILITIES WHICH TREAT, STORE OR DISPOSE OF HAZARDOUS WASTE

250.60 Scope and Purpose

250.61 Definitions

250.62 Permit Provisions

250.62-1 Conditions of Permits

250.62-2 Modification of Permits

250.62-3 Revocation of Permits

250.62-4 Schedule of Compliance in Permits

250.62-5 Duration of Permits

250.62-6 Experimental Special Permit

250.62-7 Hospital-Medical Care Facility Special Permit

250.62-8 Publicly Owned Treatment Works Special Permit

250.62-9 Special Permit for Ocean Dumping Barge or Vessel

250.63 Application for a Permit

250.63-1 Distribution of Application

250.63-2 Public Access and Confidential Information

250.64 Formulation of Tentative Determinations and Draft Permit

250.64-1 Public Notice of Tentative Determination

250.65 Request for Public Hearing and Notice of Public Hearing

250.65-1 Submission of Oral or Written Comments at Hearing

250.65-2 Hearing Officer

250.65-3 Panel Hearing

250.65-4 Opportunity for Cross-Examination

250.65-5 Recommended Decision

250.66 Administration Record

250.67 Emergency Action

250.68 Computation of Time

250.60 SCOPE AND PURPOSE

(a) These regulations apply to persons owning or operating facilities which treat, store, or dispose of hazardous waste. Upon the effective date of these regulations, no treatment, storage, or disposal of hazardous waste or operators of such facilities have applied for a permit as provided in this subpart.

(b) These regulations describe the requirements that must be satisfied before a permit is issued to the owner or operator of a facility which treats, stores, or disposes of hazardous waste, and the procedures for modification or revocation of such permits.

250.61 DEFINITIONS

For the purpose of this subpart, all terms not herein defined shall have the meaning given by the Act.

(a) The term "Act" means the Solid Waste Dispsoal Act as amended by the Resource Conservation and Recovery Act of 1976, Public law 94-580, 42 U.S.C. 6901, et seq.

(b) The term "Administrator" means the administrator of the Environmental Protection Agency.

(c) The term "applicant" means an applicant for a hazardous waste management facility permit under Section 3005 of the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976.

(d) The term "application, Part A" means that part of the application form which shall be completed by an applicant to furnish the information required for a facility to qualify for interim status under Section 3005(e) of RCRA.

(e) The term "application, Part B" means that part of the application form which shall be completed by an applicant to furnish the information required to process the full application.

(f) The term "disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water so that such hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

(g) The term "disposal facility" means any facility which disposes of hazardous waste.

(h) The term "Federal agency" means any department, agency, or other instrumentality of the Federal Government, any independent agency or establishment of the Federal Government including any government corporation, and the Government Printing Office.

(i) The term "final closure" means the measures which must be taken by an owner or operator of a facility when he or she determines that hazardous waste will no longer be accepted for treatment, storage, or disposal on the entire facility.

(j) The term "generator" means any person or Federal agency whose act or process produces hazardous waste (as defined or listed under Subpart A of this Part); provided, however, a person or Federal agency who produces and disposes of no more than 100 kilograms (approximately 220 pounds) per month of non-radioactive or non-special chemical hazardous waste (as listed under Subpart A of this Part) is not a generator.

(k) The term "groundwater" means water beneath the land surface in the saturated zone.

(l) The term "hazardous waste" means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

(1) Cause, or significantly contribute to an increase in serious irreversible, or incapacitating reversible, illness; or

(2) Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

(m) The term "hazardous waste management" means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous waste.

(n) The term "hazardous waste management facility" ('HWMF facility' or 'facility') means any land and appurtenances thereto used for the treatment, storage, and/or disposal of hazardous waste.

(o) The term "hazardous waste management facility permit" ('HWMF permit' or 'permit') means a permit issued under the Act and these regulations for the construction or operation of a facility that treats, stores, or disposes of hazardous waste.

(p) The term "incompatible waste" means a waste unsuitable for commingling with another waste or material, where the commingling might result in: (1) extreme heat or pressure generation, (2) fire, (3) explosion or violent reaction, (4) formation of substances that are shock-sensitive, friction-sensitive, or otherwise have the potential of reacting violently, (5) formation of toxic dusts, mists, fumes, gases, or other chemicals, and (6) volatilization of ignitable or toxic chemicals due to heat generation, in such a manner that the likelihood of contamination of groundwater, or escape of the substances into the environment, is increased.

(q) The term "in existence" applies to facilities which were in operation or under physical construction, or for which market studies, preliminary planning, feasibility studies or design engineering activities had been contracted for or conducted, or for which land had been obtained, or optioned on date of enactment of the Act (October 21, 1976); provided such facilities are under physical construction, or in operation upon promulgation of this subpart.

(r) The term "in operation" applies to facilities actively treating, storing, or disposing of hazardous waste.

(s) The term "leachate" means the liquid that has percolated through or drained from hazardous waste or other man-emplaced materials from which it removes soluble, partially soluble, or immiscible components.

(t) The term "long term care" means the manner in which a facility must be maintained after it no longer accepts hazardous waste for treatment, storage or disposal.

(u) The term "manifest" means the form used for identifying the quantity, composition, and the origin, routing, and destination of hazardous waste during its transportation from the point of generation to the point of disposal, treatment, or storage.

(v) The term "monitoring" means all procedures used to systematically inspect and collect data on operational parameters of facilities or on the quality of the air, groundwater, or surface water.

(w) The term "municipality" means (1) a city, town, borough, county, parish, district, or other public body created by or pursuant to state law, with responsibility for the planning or administration of solid waste management, or an Indian tribe or authorized tribal organization of Alaskan native village or organization, and includes (2) any rural community or unincorporated town or village or any other public entity for which an application for assistance is made by a state or political subdivision thereof.

(x) The term "one hundred year flood" means a flood that has a one percent or one in 100 chance of recurring in any year, or a flood of magnitude equalled or exceeded once in 100 years on the average over a significantly long period. In any given 100-year interval, such a flood may not occur, or more than one such flood may occur.

(y) The term "owner or operator" means a person owning the land on which a facility is located or the authorized agent of the owner, or a person who is responsible for the overall operation of the facility.

(z) The term "person" means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, state, municipality, commission, political subdivision of a state, interstate body or Federal agency.

(aa) The term "physical construction" means excavation, movement of earth, erection of forms or structures, the purchase of equipment, or any other activity involving the actual preparation of the facility to treat, store, or dispose of hazardous waste.

(bb) The term "Regional Administrator" means the Administrator of the regional office of the Environmental Protection Agency region in which the facility concerned is located, or his designee.

(cc) The term "storage" means the containment of hazardous waste, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous waste.

(dd) The term "storage facility" means any facility which stores hazardous waste, except generators who store their own hazardous waste for less than 90 days for subsequent transport off-site.

(ee) The term "storage tank" means any manufactured nonportable covered device used for containing pumpable hazardous waste.

(ff) The term "surface impoundment" means any natural depression or excavated and/or diked areas built into or upon the land, which are fixed, uncovered, and lined with soil or a synthetic material, and are used for treating, storing, or disposing wastes. Examples include holding ponds and aeration ponds.

(gg) The term "treatment" means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage or reduced in volume. Such term includes any activity or processing designed to change the physical form or chemical composition of hazardous waste so as to render it nonhazardous.

(hh) The term "treatment facility" means any facility which treats hazardous waste.

250.62 PERMIT PROVISIONS

(a) General. (1) No existing facility may treat, store, or dispose of hazardous waste 180 days after the promulgation of these regulations unless the owner or operator of the facility has applied for a permit as provided in section 250.63(a) of this subpart.

(2) No construction of a new facility shall commence prior to acquisition of a permit. After issuance, all construction shall be in accordance with the requirements of such permit.

(3) No modification of a facility in existence shall commence without a permit issued in accordance with this subpart. After issuance, all modifications shall be in accordance with the requirements of such permit.

(4) No new facility shall commence treatment, storage, or disposal of hazardous waste until construction of such facility is complete and:

(A) The owner or operator has submitted to the Agency a certified letter signed by the owner or operator and the licensed engineer in the state where the facility is located, who designed the facility, stating clearly that construction of the facility has complied with the permit; and

(B) the Agency has inspected the facility and such inspection reveals compliance with the terms of the permit provided that the Agency has notified the owner or operator, within five (5) days of receipt of such letter, of its intent to inspect.

(b) General application requirements. A person who is required to apply for a permit shall comply with the procedural and informational requirements of section 250.63 unless otherwise specified in sections 250.62-6, 250.62-7, 250.62-8, and 250.62-9.

(c) Conditions for separate processes. In permits issued under the Act and these regulations, the Regional Administrator may impose specific conditions for separate processes or operations in the facility.

250.62-1 Conditions of Permits

In addition to the permit requirements of these regulations, the Regional Administrator shall insure that the terms of all permits issued specifically include the following:

(a) Operation and maintenance. All approved procedures of operation and maintenance are consistent with the requirements of these regulations, the Act, and the standards in Subpart D.

(b) Modification. A permit may be modified only as provided in section 250.62-2.

(c) Revocation. A permit may be revoked only as provided in section 250.62-3 and section 3008(b) of the Act.

(d) Violation of Act and permit. The operation and maintenance of a facility in violation of the terms of the permit shall constitute a violation of the permit and the Act.

(e) Monitoring, recordkeeping and reporting. Failure to maintain monitoring, recordkeeping, and reporting requirements in compliance with the permit and the standards in Subpart D, shall constitute a violation of the terms of the permit and the Act.

(f) Inspections. Under section 3007 of the Act, the permittee, upon request of the Regional Administrator or his authorized representative, shall furnish all records concerning the hazardous waste treated, stored, or disposed of at the facility. In addition, the permittee shall allow the Regional Administrator or his representative, upon the presentation of his credentials, at all reasonable times, to inspect the facility and have access to and copy all records concerning the hazardous waste treated, stored, or disposed of at the facility.

(g) Operation of control systems. The permittee shall at all times maintain in good working order and operate as efficiently as possible any facilities or systems of control installed or used by the permittee to achieve compliance with the terms of the permit.

(h) Changed hazardous waste characteristics, lists or standards. If the characteristics or lists for defining a hazardous waste in Subpart A are changed from the characteristics or lists applied in the permit, or the applicable standards in Subpart D are changed, the Regional Administrator shall modify the permit in accordance with the changed hazardous waste characteristics, lists, standard or prohibition and so notify the permittee.

(i) Contingency plan. A contingency plan, approved by the Regional Administrator, which outlines emergency or remedial actions necessary, including but not limited to, contacting appropriate persons and agencies for each waste in the event of spillage, leakage, or other emergency situation, shall be in effect at all times.

(j) Financial responsibility. Failure to maintain financial responsibility for continuity of operation and ownership, for claims arising as a result of operation of the facility, and for facility closure and post-closure maintenance, as required in the permit and standards in Subpart D, shall constitute a violation of the terms of the permit.

250.62-2 Modification of Permits.

(a) When a permit may be modified. Any proposed expansion or modification of a facility, increases in the volume of hazardous waste to be treated, stored or disposed of, or any changes in the type of hazardous waste to be treated, stored, or disposed of must be immediately reported to the Regional Administrator for a determination of whether the existing permit must be modified. The Regional Administrator shall require that all relevant information concerning the proposed expansion, modification or changed conditions be submitted and a determination of whether the permit should be modified shall be made for good cause including a consideration of whether:

(1) The operation of the facility will be substantially affected and new conditions of operation and maintenance will be required; or

(2) The threat to the public health or environment will be materially increased.

(b) Compliance schedules for modifications. Any modification of a permit shall include a schedule of compliance which satisfies the requirements of section 250.62-4.

250.62-3 Revocation of Permits.

(a) When a permit will be revoked. In addition to all other enforcement and administrative remedies available, the Regional Administrator may, pursuant to Section 3008(b) of the Act, revoke a permit, in whole or in part, during its own term for cause, including:

(1) Violation of any term of the permit, applicable regulations, or the Act;

(2) Misrepresentation or an inaccurate description of any material fact in the permit application, or failure to disclose all relevant facts in the permit application; or

(3) Other good cause for the revocation.

250.62-4 Schedule of Compliance in Permits.

(a) Time for Compliance. For any facility which is not in compliance with applicable regulations and the Act, the permittee shall take specific steps to achieve compliance within the shortest reasonable period of time and subject to the procedural requirements of this regulation.

(b) Compliance schedules in permits. All schedules of compliance shall be set forth in permits as follows:

(1) For any schedule of compliance which exceeds 6 months, the schedule shall set forth interim requirements and the dates for their achievement. In no event, however, shall more than six months elapse between interim dates, nor more than three years elapse from the date of the original compliance schedule to the final date of compliance. If the time necessary is more than six months and is not readily divided into stages for completion, interim dates shall be specified for the submission of progress reports toward completion of the interim requirement.

(2) Not later than 14 days following each interim date and the final date of compliance, the permittee shall provide the Regional Administrator with written notice of the permittee's compliance or noncompliance with the interim or final requirements.

250.62-5 Duration of Permits.

Except as provided in section 250.62-6 a permit shall be issued for the projected life of a facility.

250.62-6 Experimental Special Permit.

(a) Who may receive a permit. The Regional Administrator may grant a HWMF experimental special permit to a person who is engaged in technology advancing activities which are intended to improve the state-of-the-art for hazardous waste treatment, storage, or disposal.

(b) Application. An applicant for a HWMF experimental special permit shall submit that portion of the information specified in section 250.63(h) that is relevant to the technology involved and the applicable Subpart D standards. In reviewing the application, the Regional Administrator may direct that the application be given priority review.

(c) Termination. If a HWMF experimental special permit is granted, the Regional Administrator shall set a specific date for its termination.

250.62-7 Hospital-Medical Care Facility Special Permit.

(a) Who may receive a permit. A person who owns or operates a hospital or medical care facility which treats or stores hazardous waste may apply for a HWMF hospital-medical care facility special permit if the following conditions are satisfied:

(1) The hospital or medical care facility is licensed under a state licensing law which provides for the review and approval of a program for the storage, sterilization, incineration, or treatment of all hazardous waste generated;

(2) The state licensing law provides for the enforcement of that program;

(3) If incineration is used, the incinerator is operated under the terms and conditions of a permit issued under applicable state law; and,

(4) The person owning or operating the facility submits a certification of compliance with this section signed by the appropriate state licensing official.

(b) Application. Instead of the comprehensive application requirements of section 250.63(h) an applicant for a HWMF hospital-medical care facility special permit shall submit the following information:

(1) The name and address of the facility.

(2) The information described in section 250.63(h)A(2) and 250.62(h)B(5).

(3) A detailed hazardous waste maintenance and control plan, which shall include but not be limited to: (i) a description of how hazardous waste will be stored or treated within the facility;

(ii) how access to or contact with the hazardous waste will be controlled; and (iii) a plan for segregation of incompatible waste.

250.62-8 Publicly Owned Treatment Works Special Permit.

(a) Who must obtain a permit. A person who owns or operates a Publicly Owned Treatment Works (POTW) facility that accepts for treatment hazardous waste transported to the facility by truck or rail, under a manifest required by Subpart B, must obtain a HWMF/POTW special permit. However, no facility shall be eligible for a special permit if the hazardous waste accepted for treatment does not meet all of the pretreatment standards established under Section 307 of the Clean Water Act of 1977.

(b) Application. An applicant for a HWMF/POTW special permit shall submit that portion of Part A of the application described in section 250.63(h)A(2), and shall comply only with the reporting and recordkeeping requirements of Subpart D.

250.62-9 Special Permit for Ocean Dumping Barge or Vessel.

(a) Who must obtain a permit. A person who owns or operates a barge or other vessel that accepts hazardous waste, delivered directly to the barge or vessel under a manifest required by subpart B, must obtain a HWMF/Ocean Dumping Facility Special Permit. For purposes of these regulations, the barge or other vessel is considered a "facility." The Regional Administrator may grant a HWMF/Ocean Dumping Facility Special Permit only to a person who has obtained a valid ocean dumping permit under conditions specified in regulations published under 40 CFR Parts 220-227.

(b) Application. An applicant for a HWMF/Ocean Dumping Facility Special Permit shall submit that portion of Part A of the application described in Section 250.63(h) A(2), and shall comply only with the reporting and recordkeeping requirements of Subpart D.

250.63 APPLICATION FOR A PERMIT

(a) Facilities in existence. Any person who owns or operates a facility for the treatment, storage, or disposal of hazardous waste which is in existence, as defined in Section 250.61(q) of this subpart, shall apply for a HWMF permit within six months after the date upon which these regulations are promulgated. No treatment, storage or disposal of hazardous waste at the facility may occur after such date unless such application has been received. To satisfy the application deadline of this subsection, and to qualify for interim status under section 3005(e) of the Act, an applicant shall submit only the information required in Part A of the application (Subsection (h)A of this Section). A date for submittal of Part B of the application shall be established by the Regional Administrator at a later date. Failure to submit Part B of the application by the date established by the Regional Administrator shall constitute an immediate loss of interim status.

(b) Owners or operators. The owner or operator of a hazardous waste management facility, or the authorized agent of either, must submit and sign an application for a permit as required by this regulation. An unsigned or improperly signed application shall be considered incomplete.

(c) Applications by corporations, partnerships and governmental entities. An application submitted by a corporation must be signed by a principal executive officer of at least the level of vice president, or his authorized representative, if that representative is responsible for the overall operation of the facility. In the case of a partnership or a sole proprietorship, the application must be signed by a general partner or the proprietor respectively. In the case of a municipal, state, Federal or other public facility, the application must be signed by either a principal executive officer, appropriate elected official, or other duly authorized employee. An unsigned or improperly signed application shall be considered incomplete.

(d) Engineering, hydrologic and geologic information. All application information and plans for the design of a facility shall be certified by a professional engineer licensed to practice in the state where the facility is or will be located. All information concerning hydrology and geology shall be certified by a professional in the discipline. In each instance, the engineer, hydrologist and geologist certifying the information shall list all relevant educational qualifications and professional licenses. An uncertified or improperly certified application shall be considered incomplete.

(e) Applications for new facilities. Any person proposing to construct a new facility for the treatment, storage, or disposal of hazardous waste shall apply for a HWMF permit a reasonable time before physical construction is anticipated to commence. Both Part A and Part B of the application must be submitted before Agency evaluation begins. Physical construction of a new facility may not begin until a final permit has been issued as provided in these regulations.

(f) Complete applications. All applications submitted to the Regional Administrator shall provide all information required by the application form and such other information as the Regional Administrator requests. Within 30 days of receipt of an application the Regional Administrator shall determine if the application is complete and shall notify the applicant, in writing, of such determination. If the Regional Administrator determines the application is not complete within 30 days, the Regional Administrator shall return the application to the applicant specifically stating what information must be provided to render the application complete. An application shall not be considered as submitted to the Regional Administrator until it is in complete form.

(g) Application forms and copies submitted. An applicant for a HWMF permit may obtain the required forms and directions for preparing an application from the Regional Administrator. An original and two copies of the application shall be submitted to the Regional Administrator.

(h) Specific application information. Unless otherwise specifically provided in sections 250.62-6, 250.62-7, 250.62-8, and

250.62-9, the application for a HWMF permit shall include all relevant information concerning compliance with the standards in subpart D, including, but not limited to, the following:

A. Part A of the Application

(1) A description of the boundaries of the facility, including a topographic map of the area for a distance of one mile (1.6 km) beyond the boundaries of the facility. The topographic map submitted shall have a scale of one inch (2.5 cm) equal to not more than 500 feet (145 m) and have a contour interval not greater than 20 feet (5.9 m). The map shall also indicate the location of facility structures and all known or recorded wells, springs, and surface water bodies located within the area covered by the map.

(2) A detailed description of:

(i) the hazardous waste to be handled at the facility by its Department of Transportation (DOT) proper shipping name (49 CFR 172), or by the EPA name (as identified or listed in subpart A) if the DOT proper shipping name is not applicable. However, if the DOT proper shipping name "NOT OTHERWISE SPECIFIED" (NOS) is used, the EPA name (as identified or listed in Subpart A) must be included.

(ii) the hazard class of each waste as identified or listed under the DOT hazard class (49 CFR 172) or by the EPA characteristics (as identified in subpart A) if the DOT hazard class is not applicable. However, if the DOT proper shipping name "OTHER REGULATED MATERIAL" (ORM) is used, the EPA characteristic (as identified in Subpart A) must be included.

(iii) the annual quantity of each hazardous waste to be treated, stored, or disposed of;

(iv) the units of volume or weight, for each quantity in either the metric or the English system;

(v) how the hazardous waste is to be treated, stored, or disposed of at the facility; and

(vi) copies of drawings and specifications for the facility, if available.

B. Part B of the Application

(1) A master plan for the facility which shall include a detailed description of:

(i) any structures, buildings, equipment or machinery to be used at the facility including site preparation plans, design plans, and specifications for treatment, storage or disposal facilities;

(ii) a detailed plan of operation and maintenance, including operating conditions, projected hours of operation, security and access control, plans for covering and compaction, plans for controlling odor and air pollution, plans for vector control, and other related items;

(iii) the life of the facility based on the projected use and the expansion potential and plans for the facility after final closure;

(iv) the steps that will be taken to control leachate production at the facility, including the period after closure;

(v) the contingency plan for emergency situations, including the procedures, equipment, and facilities to be used, a listing of the fire departments, ambulance services, hospitals, and other emergency services that will serve the facility and the response time, the person responsible for implementing the contingency plan, the on-site plan for fire control, and other related information;

(vi) the plan for final closure of the facility, including the estimated cost of final closure, post closure expenses, proposed future uses of the facility, and proposals for controlling access;

(vii) the plan for long-term care of the facility after final closure for disposal operations;

(viii) the plan for visual inspections of facility conditions and for monitoring air and water pollution, including the period after final closure; and

(ix) the plan for segregation of incompatible wastes and how wastes will be placed or located within the treatment, storage, or disposal facility

(2) A detailed description of site geology and the area within one thousand feet (290 m) of the boundaries of the facility, including a description of physiography, drainage patterns and divides, soil depth and types including chemical and physical properties; a detailed description of the geologic column including intrusive bodies, folds, fractures, faults, joints, and fracture traces. Where access to adjacent properties for obtaining geological data may be limited, data available from public sources may be substituted.

(3) For disposal facilities and surface impoundment facilities, a detailed description of the site hydrology and the area within one thousand feet (290 m) of the boundaries of the facility, including known or recorded springs, depth to ground water, thickness, extent, characteristics of aquifers, perched water zones, aquitards and aquicludes, porosity and permeability of soils, direction and rate of flow of ground water, recharge and discharge areas, distance to surface water, location of public, livestock, and private water supplies, background quality of groundwater as specified in Subpart D, and other related items. Where access to adjacent properties for obtaining hydrological data may be limited, data available from public sources may be substituted.

(4) A description of the climate in the area, including average annual rainfall, average annual evapotranspiration rates, average annual wind speed, prevailing wind direction, and other factors that may affect water or air pollution.

(5) A listing of the qualifications of the persons responsible for the operation of the facility, including education, training, and work experiences, and a description of the training program to be used to prepare persons to operate and maintain the facility in a safe, environmentally adequate manner.

(6) A listing of the applicant's performance bonds, insurance carriers and policies, or other instruments which constitute continued financial responsibility in accordance with standards in Subpart D.

(7) The Regional Administrator may waive any of the application requirements in Part B of the application if he or she determines that the information is not needed to establish compliance with the standards in Subpart D. A request for a waiver of Part B application information shall be submitted in writing by the applicant and shall state why the information is not needed to determine compliance with the standards in Subpart D. The Administrator shall grant or deny the waiver request in writing, including a statement of the reasons for the decision, within thirty (30) days.

250.63--1 Distribution of Application.

(a) Distribution. After receiving a complete application for a permit (Part A and Part B), as provided in these regulations, the Regional Administrator shall make available a copy of the application form to each of the following:

(1) the appropriate state agency in the state where the proposed hazardous waste management facility will be located;

(2) the chief executive or legislative officer of any municipality within a 10 mile (16 km) radius of the proposed facility; and

(3) the public library serving the location of the facility.

(b) Summary of Application and Public Notice. In addition to the requirements of subsection (a) of this section, the Regional Administrator shall prepare a summary of the application for distribution to the persons listed in subsection (a) of this section and other interested persons. A public notice announcing availability of the summary shall be circulated using the procedures described under section 250.64-1(a). The summary shall state where complete copies of the application are available for inspection, the person in the regional office who can be contacted about the application, and that comments may be submitted to EPA on the content of the application, the adequacy of the information submitted, the approval, or disapproval of the permit, possible permit conditions, and other related matters during the period of permit review by EPA. The summary shall also state that following the issuance of a tentative determination on the permit application as provided in section 250.64 of these regulations, all interested persons will be given an opportunity to comment on the tentative determination.

(c) Reasonable charge for reproducing applications. If an interested person requests a complete copy of the application, the Regional Administrator may assess a reasonable charge for copying and distributing the application.

250.63-2 Public Access and Confidential Information.

Any information concerning an application for a permit shall be available to any person to the extent and in the manner authorized by section 3007(b) of the Act, the Freedom of Information Act, 5 U.S.C. 552, and the EPA confidential regulations in Part 2, Subpart B of this Title.

250.64 FORMULATION OF TENTATIVE DETERMINATIONS AND DRAFT PERMIT

(a) Content. The regional staff shall formulate and prepare tentative determinations with respect to each permit in advance of public notice of the proposed issuance, denial or modification of the permit. The tentative determination on a permit application shall include at least the following:

(1) A tentative determination to issue, deny or modify a permit for the facility described in the application;

(2) A statement of the reasons for the tentative determination to issue, deny, or modify the permit, including an explanation of the factual, legal, methodological and policy issues considered in reaching the tentative determination and how they were resolved;

(3) A summary of any request for a waiver of application information submitted and granted in accordance with section 250.63(h)(7); and

(4) If the determination made in subsection (a)(1) of this section is to issue or modify the permit, the following tentative conditions shall be included:

(i) proposed conditions concerning the construction, modification, operation, and maintenance of the facility;

(ii) the proposed control, monitoring, recordkeeping and reporting requirements that will be applicable to the proposed facility; and

(iii) a brief description of any other proposed conditions required to satisfy the provisions of the Act and these regulations.

(b) Basis for tentative determination. The tentative determination shall be accompanied by a listing of all materials considered by EPA in developing the tentative determination. Copies of all materials shall be included in the administrative record under section 250.66, except that published material which is generally available may be cited instead.

(c) Draft permit. The regional staff shall organize the tentative determination prepared pursuant to subsection (a) of this section into a draft permit.

250.64-1 Public Notice of Tentative Determination.

(a) Public Notice. Public notices of tentative determination to issue, deny, or modify a permit shall be circulated in a manner designed to inform interested and potentially interested persons of such tentative determination. Procedures for circulation of public notice shall include but not necessarily be limited to the following:

(1) posting notice in the post office and public places of the municipality in which the applicant is located; and

(2) publication in a daily newspaper of general circulation in the municipality in which the applicant is located.

(b) Individual notice. Individual notice of such tentative determination shall be mailed to the applicant by certified mail, return receipt requested, to the persons listed in section 250.63-1, and to persons who have submitted a request for individual notice in compliance with the requirements of subsection (c) of this section.

(c) Request for individual notice. EPA shall mail notice of its tentative determination to issue, deny, or modify a permit to any person upon request. A request shall be submitted to the Regional Administrator in writing, stating that the request is for individual notice of tentative determination to issue, deny, or modify any permit under section 3005 of the Act, and describing the notice or types of notices desired (e.g., all notices, notices for a particular region, notices for a particular state, or notice for a particular municipality).

(d) Form of notice. The notice of a tentative determination distributed under subsections (a), (b) and (c) of this section shall include, in addition to any other materials, the following:

(1) A summary of the information contained in the application;

(2) The tentative determination prepared under section 250.64;

(3) A brief description of the procedures set forth in section 250.65 for requesting a public hearing, including a statement that a request for a public hearing must be filed within 30 days of the date of the notice;

(4) A statement that written comments on the tentative determination submitted to EPA within 60 days of the date of notice will be considered by EPA in making a final decision on the application;

(5) The location of the administrative record and the location at which interested persons may obtain further information concerning the tentative determination, including a copy of the application, and any studies relating to the tentative determination; and

(6) Such additional statements, representation, or information as the Regional Administrator considers necessary or proper.

250.65 REQUEST FOR PUBLIC HEARING AND NOTICE OF PUBLIC HEARING

(a) Request for public hearing. Within thirty (30) days of the date of publication or mailing of the notice required by section 250.64-1, any person may request the Regional Administrator to hold a public hearing on the tentative determination by submitting a written request containing the following:

(1) Identification of the person requesting the hearing and the persons interest in the proceeding;

(2) A statement of any objections to the tentative determination; and

(3) A statement of the issues which the person requesting a hearing proposes to raise for consideration at such hearing.

(b) Grant or denial of hearing -- notification. Whenever (1) a written request satisfying the requirements of subsection (a) of this section has been received and presents genuine issues, or (2) the Regional Administrator determines in his/her discretion that a public hearing is necessary or appropriate, the Regional Administrator shall give written notice of his or her determination to each person requesting a hearing and the applicant, and shall provide public notice of his or her determination in accordance with sections 250.64-1(a) or (b). If the Regional Administrator determines that a request filed under subsection (a) of this section does not comply with the requirements of subsection (a) or does not present genuine issues, he or she shall give written notice of his or her determination to the person requesting the hearing.

(c) Form of notice of hearing. A notice of hearing issued under subsection (b) of this section shall contain:

(1) A statement of the time and place of the hearing;

(2) The information required by paragraphs (d) (1) and (d) (2) of section 250.64-1;

(3) A statement identifying the place at which the administrative record on the tentative determination is located, the hours during which the office will be open for public inspection, and the documents contained in the record as of the date of the notice of hearing;

(4) The name, address, and office telephone number of the Record and Hearing Clerk for the hearing; and

(5) A statement indicating that any person may be represented by counsel in any hearings and proceedings under the provisions of these regulations.

(d) Effect of denial or absence of request for hearing. If no request for a hearing is made under this section, or if all such requests are denied under subsection (b) of this section, the tentative determination issued under section 250.64 shall be considered a recommended decision issued under section 250.65-5, except that for purposes of section 250.65-5, the term "hearing participant" or "person who participated in the hearing" shall be constructed to mean the applicant and any person who submitted written comments.

250.65-1 Submission of Oral or Written Comments at a Hearing.

(a) Right to comment. Any person shall be permitted to submit oral or written statements and data concerning a permit at a public hearing except as otherwise provided in these regulations.

(b) Reply comments. No later than 15 days after the close of the hearing, or at a date specified in the hearing notice, each person who participated in the public hearing may file with the Record and Hearing Clerk comments, on the following:

(1) Written comments submitted by persons in response to section 250.63-1;

(2) Written comments submitted in response to the notice specified in sections 250.64-1 and 250.65;

(3) Material in the hearing record; and

(4) Material which was not and could not reasonably have been available prior to the deadline for submission of comments under subsection (a) of this section.

(c) Form of comments. All written comments shall be submitted in quadruplicate and shall include any affidavits, studies, tests or other materials relied upon for making any factual statements in the comments.

250.65-2 Hearing Officer.

(a) Assignment of Hearing Officer. Upon granting a request for hearing under Section 250.65, the Regional Administrator shall appoint as Hearing Officer an EPA employee having special expertise in the areas related to the issues to be addressed at the hearing.

(b) Powers and duties of Hearing Officer. It shall be the duty of the Hearing Officer to conduct a fair and impartial hearing, assure that the facts are fully elicited, and avoid delay. Between the time a Hearing Officer is assigned and the time a decision is issued, the Hearing Officer shall have authority to:

(1) Chair and conduct administrative hearings held under these regulations;

(2) Administer oaths and affirmations;

(3) Receive relevant evidence, provided that the administrative record, as defined in section 250.66, shall be received in evidence;

(4) Consider and rule upon motions, dispose of procedural requests, and issue all necessary orders;

(5) Hold conferences for the purpose of settling or simplifying the issues or expediting the proceedings; and

(6) Perform all other acts and take all action necessary for the maintenance of order and for the efficient, fair and impartial conduct of proceedings under these regulations.

250.65-3 Panel Hearing.

(a) Composition of hearing panel. A Hearing Officer shall preside at the hearing held under these regulations. An EPA panel shall also take part in the hearing. The membership of the panel shall consist of EPA employees having special expertise in areas related to the issues to be addressed at the hearing.

(b) Additional hearing participants. Either prior to the commencement of the hearing or during the hearing, the Hearing Officer may request that a person not then scheduled to participate in the hearing (including an EPA employee or a person identified by any scheduled hearing participant as having knowledge concerning the issues raised for discussion at the hearing) make a presentation or make himself available for discussion at the hearing.

(c) Questioning of hearing participants. The Hearing Officer and panel members may question any person participating in the hearing. Persons in the hearing audience, including other hearing participants, may submit written questions to the Hearing Officer for the Hearing Office to ask the participants. The Hearing Officer may, in his discretion, ask the questions or indicate that the questions will not be asked because they are not relevant or are repetitious.

(d) Submission of additional material. Participants in the hearing shall submit for the hearing record any additional material that the Hearing Officer may request within 15 days after the close of the hearing, or such other period of time as may be ordered by the Hearing Officer. Participants may also submit additional information for the hearing record on their own accord within 15 days after the close of the hearing.

(e) Transcript. A verbatim transcript shall be made of the hearing.

250.65-4 Opportunity for Cross-Examination.

(a) Request for cross-examination. After the close of the panel hearing, any participant in the hearing may submit a written request for cross-examination. The request shall be submitted to the Hearing Officer within 10 days after a full transcript of the hearing becomes available and shall specify:

(1) The disputed issues of material fact for which cross-examination is requested. The participant shall explain why the questions at issue are factual, rather than of an analytical or policy nature, the extent to which they are in dispute based on the record, and why the issues are material to the decision on the permit; and

(2) The persons the participant desires to cross-examine and an estimate of the time necessary. The request shall include a statement as to why cross-examination of the witness in question may elicit information not previously discussed.

(b) Order granting or denying request for cross-examination. As expeditiously as practicable after receipt of all requests for cross-examination under subsection (a) of this section, the Hearing Officer shall issue an order either granting or denying each request, which shall be disseminated to all persons requesting cross-examination and all persons to be cross-examined. If any request for cross-examination is granted, the order shall specify:

(1) The issues as to which cross-examination is granted;

(2) The persons to be cross-examined on each issue;

(3) The persons allowed to conduct cross-examination; and

(4) The date, time and place of the supplementary hearing at which cross-examination shall take place.

(c) Supplementary hearing. The Hearing Officer and at least one member of the original hearing panel shall preside at the supplementary hearing. During the course of the hearing, the Hearing Officer shall have authority to modify any order issued under subsection (b) of this section. A verbatim transcript shall be made of this hearing.

(d) Alternatives to cross-examination.

(1) No later than the time set for requesting cross-examination, a hearing participant may request that alternative

methods of clarifying the record (such as the submittal of additional written information) be used in lieu of or in addition to cross-examination. The Hearing Officer shall issue an order granting or denying each request at the time he issues an order under subsection (b) of this section. If the request is granted, the order shall specify the alternative to be used and any other relevant information (e.g., the due date for submitting written information).

(2) In passing on any request for cross-examination submitted under subsection (a) of this section, the Hearing Officer may, as a precondition to ruling on the merits of a request, require that alternative means of clarifying the record be used whether or not a request to do so has been made under the preceding subsection. The person requesting cross-examination shall have 10 days to comment on the results of using alternative methods, following which the Hearing Officer shall issue an order granting or denying a person's request for cross-examination.

250.65-5 Recommended Decision.

(a) Preparation of decision. The Regional Administrator shall designate the Hearing Officer or an EPA employee who has been a member of the hearing panel to evaluate the record of the hearing, and prepare and file a recommended decision with the Record and Hearing Clerk. This decision shall contain findings of fact, conclusions regarding all material issues of law, fact or discretion, and a recommendation as to whether the permit should be issued, denied, or modified in whole or in part. After the recommended decision has been filed, the Hearing and Record Clerk shall serve a copy of the recommended decision on each hearing participant and the Regional Administrator.

(b) Effect of recommended decision. The recommended decision shall become the final decision of the Regional Administrator within 30 days after service by the Hearing and Record Clerk.

250.66 ADMINISTRATIVE RECORD

(a) Establishment of record.

(1) Upon receipt of an application for a permit or permit modification, an administrative record for that application shall be established, and a Record and Hearing Clerk appointed to supervise the filing of documents in the record and to carry out all other duties assigned by these regulations.

(2) All material in the record shall be appropriately indexed and available for public inspection during regular EPA business hours. The Record and Hearing Clerk shall make appropriate arrangements to allow members of the public to copy record materials. All material required to be included in the record shall be added to the record as soon as feasible after receipt by EPA.

(b) Record for issuing tentative determination. The administrative record for issuing the tentative determination required by section 250.64 shall consist of the application for a permit or permit modification (plus attachments), the draft permit, comments received as a result of the notice issued under section 250.63-1, an application information waiver request made or granted in accordance with section 250.63(h)(7), and any other material supporting the tentative determination which are cited or discussed in the tentative determination.

(c) Record for acting on requests for cross-exammination. The administrative record for acting on requests for cross-examination under section 250.65-4 shall consist of the record for issuing the tentative determination, all comments timely submitted under sections 250.63-1 and 250.65-1, the transcript of the hearing, and any additional material timely submitted under section 250.65-4.

(d) Record for preparation of recommended decision. The administrative record for preparation of the recommended decision required by section 250.65-5 shall consist of the record for acting on requests for cross-examination, the transcript of any supplementary hearing held under section 250.65-4(c), and any materials timely submitted in lieu of or in addition to cross-examination under section 250.65-4(d).

(e) Record for issuance of final decision.

(1) Where no hearing has been held, the administrative record for issuance of the Regional Administrator's final decision shall consist of the record for issuing the tentative determination, any comments timely submitted under section 250.64-1, and any other information which the Regional Administrator considers relevant and

which has been identified on or prior to the date of issuance of the final decision.

250.67. EMERGENCY ACTION

Notwithstanding any other provision of these regulations, the Regional Administrator may, under emergency circumstances, issue temporary written authorization to a permitted facility, not to exceed ninety days in duration, to allow the treatment, storage or disposal of hazardous waste not covered by the existing permit. Such authorization shall clearly specify the wastes to be treated, stored, or disposed, and the manner and location of such treatment, storage, or disposal. The Regional Administrator may issue such a temporary authorization only if he or she finds that there is available no alternative and environmentally-preferable method of treatment, storage or disposal. Such authorization shall not be renewable, and may be rescinded at any time during the 90-day period if the Regional Administrator determines that public health and the environment may be adversely impacted.

250.68 COMPUTATION OF TIME

(a) In computing any period of time prescribed in the regulations to implement the Act, unless otherwise expressly provided, the day on which the designated period of time begins to run shall not be included. The last day of the period so computed is to be included unless it is a Saturday, a Sunday or a legal holiday on which the Environmental Protection Agency is not open for business, in which event the period runs until the end of the next day which is not a Saturday, Sunday, or a legal holiday. Intermediate Saturdays, Sundays, and legal holidays shall be excluded from the computation when the period of time prescribed or allowed is seven (7) days or less.

SUBPART F--GUIDELINES FOR STATE HAZARDOUS WASTE PROGRAMS

250.70 Scope and purpose

250.71 Definitions

250.72 Authorization (3006b)

250.73 Interim Authorization (3006c)

250.74 Federal oversight of authorized programs

250.75 Application procedure

250.76 Withdrawal of authorization

250.70 SCOPE AND PURPOSE

(a) Section 3006 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6926), requires the Administrator, after consultation with State authorities, to promulgate guidelines to assist States in the development of State hazardous waste programs.

(b) These guidelines describe the various provisions and capabilities a State hazardous waste program must have in order to qualify for authorization under section 3006(b) or section 3006(c), which provide that the State, in lieu of the Federal EPA, may administer and enforce the hazardous waste management regulatory program established pursuant to Subtitle C of the Act. The guidelines also describe the substantive and procedural requirements for States applying for authorization, EPA's oversight of the State's hazardous waste program, and for the withdrawal of authorization pursuant to section 3006(e).

(c) In addition, section 3009 of the Act prohibits States from imposing any requirement which is "less stringent" than EPA's regulations under sections 3001 through 30054 of the Act, a prohibition which applies whether or not the State is authorized under section 3006.

250.71 DEFINITIONS

For the purposes of this part:

(a) The term "Administrator means the Administrator of the Environmental Protection Agency.

(b) The term "authorization" or "authorized" refers to a State which has an approved hazardous waste program under section 3006(b) or 3006(c) of the Act and §§ 250.72 and 250.73.

(c) The term "element" means a function of the State program which EPA considers necessary for a State hazardous waste program to be equivalent to that of EPA.

(d) The term "full authorization" refers to authorization of a State program which has met the substantive and procedural requirements of section 3006(b) of the Act and § 250.72(a).

(e) The term "hazardous waste management" means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous wastes.

(f) The term "interim authorization" refers to authorization by EPA of a State program which has met the substantive and procedural requirements of section 3006(c) of the Act and § 250.73.

(g) The term "oversight" refers to a continuing program of surveillance and review carried out by EPA to insure that each authorized State's hazardous waste management program remains in compliance with the requirements for authorization stated in this Part.

(h) The term "partial authorization" refers to authorization by EPA of a State program to administer and enforce selected program components of a fully authorized hazardous waste program while EPA carries out the remaining parts. In all cases, the combination of the State and EPA hazardous waste program shall meet the substantive and procedural requirements of section 3006(b) of the Act and § 250.72(a).

(i) The term "withdrawal" refers to the termination of authorization for a State hazardous waste program under section 3006(e) of the Act and § 250.76.

(j) The term "State" means any of the several States, and the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands.

250.72 AUTHORIZATION (3006b)

(a) Full authorization. This section describes the various provisions to be met and capabilities to be demonstrated by States seeking to apply to the Regional Administrator for full authorization. The Regional Administrator shall apply the criteria identified in § 250.72(a)(1) through § 250.72(a)(3) in determining whether the program of any State is "equivalent to" the Federal program, "consistent with" the Federal program and with those applicable in other States, and whether the State's program provides "adequate enforcement of compliance," as required by section 3006(b) of the Act. A negotiated Memorandum of Understanding, as described in § 250.74(a), is required for full authorization.

(1) Equivalency. The Regional Administrator shall measure the "equivalency" of a State program to the Federal program by

determining whether the State program encompasses all the following elements, and by assessing the adequacy of each of the administration and enforcement of a hazardous waste program: Legislative Authority; Published Regulations; Permit Mechanism; Manifest System; Identification of Resources; Interagency Delineation of Responsibilities (if appropriate to the applicant State); and Public Participation.

(i) Legislative authority. (A) A State seeking full authorization shall demonstrate legislative authority to provide the following program components: regulations governing hazardous waste generators, transporters and owners and operators of hazardous waste treatment, storage and disposal facilities, including the keeping of records and submittal of reports and the establishment of monitoring practices; control of the treatment, storage and disposal of hazardous waste through a permit system or its equivalent; a waste tracking system (manifest system); the power to conduct inspections and take samples; and the power to institute enforcement proceedings against violators.

(B) The State legislative authority and regulatory program shall be applicable both to those hazardous wastes stored, treated or disposed of at the site of generation (so-called "on-site" management), and to those hazardous wastes shipped elsewhere for storage, treatment, or disposal.

(ii) Published regulations. The State may choose to publish its own regulations with respect to hazardous waste management, adopt the regulations promulgated by EPA under sections 3001 through 3005 of RCRA unchanged, or adapt EPA's regulations to unique or unusual circumstances of conditions within the State. Where a State has existing regulations or proposes new regulations which are different from those of EPA, the Regional Administrator shall evaluate the published regulations of the State's agencies for their equivalency to those of EPA. The State's regulation shall address the identification of hazardous waste and shall contain standards applicable to generators of hazardous waste, transporters of hazardous waste, and the owners and operators of hazardous waste treatment, storage and disposal facilities. State regulations may not impose any requirement which is "less stringent" than EPA's regulations under sections 3001 through 3005 of the Act.

(iii) Permit mechanism. A State seeking full authorization shall provide for a permit system applicable to facilities which treat, store, or dispose of hazardous wastes, which consists of an administrative and legal framework together with resources sufficient to: accept, process and review applications for permits; issue permits (with appropriate special conditions); monitor renewals and expirations of permits; monitor compliance with the terms and conditions of permits; enforce compliance with the terms and conditions of permits; and enforce against owners and operators who have not acquired permits. The Regional Administrator shall evaluate the systems of those applicant States where the term "permit," is not used in order to determine whether mechanisms such as "license," "letters of approval," "waste discharge requirements," or other control devices, regardless of terminology, satisfy the intent of the Act.

(iv) Manifest system. A State seeking full authorization shall demonstrate the administrative capability to oversee the waste transportation manifest system established under section 3002(5) of the Act. Such capability shall include the management of manifests involving both intrastate and interstate transportation of hazardous wastes. States seeking full authorization under these Guidelines shall agree to use the manifest format published by the Administrator in the FEDERAL REGISTER pursuant to Section 3002 in administering and enforcing their hazardous waste management programs, but may supplement that format as appropriate to meet specific requirements or needs.

(v) Identification of resources. The Regional Administrator shall evaluate the resources proposed by an applicant State to be applied to its hazardous waste management program in order to ascertain that the State is able to administer and enforce the program successfully. The Regional Administrator shall consider the following factors in evaluating the adequacy of the State's proposed resources: (A) A comparison with levels of resources known to have been applied in other States of commensurate size, hazardous waste generation and disposal frequency; and (b) the adequacy of those resources in relation to the level of success of those other State programs. Consequently, State applications for full authorization under Section 3006(b) shall clearly identify the personnel and the monetary resources to be used to carry out each responsibility necessary to conduct a comprehensive hazardous waste management program.

(vi) Interagency delineation. A State seeking full authorization in which more than one agency is involved in the administration and enforcement of the State hazardous waste program shall explicitly delineate the responsibilities of each such agency which relate to hazardous waste management, and shall designate a "lead agency," for the purposes of these Guidelines, to facilitate communications between EPA and the agencies responsible for the State program, and to receive such grant funds as may be made available under section 3011 of the Act. This "lead agency" may be the same agency designated under 40 CFR Part 255, "Identification of Regions and Agencies for Solid Waste Management (Interim Guidelines)." The "lead agency" should provide for coordination with the State agency responsible for the regulation of injection wells under the Underground Injection Control (UIC) program administered under Part C of the Safe Drinking Water Act of 1974 (P.L. 93-532, 42 U.S.C. 300f, et seq.) unless the agency responsible for the UIC program is the same as the "lead agency" described above.

(vii) Public participation. A State seeking full authorization shall submit a public participation plan as part of the application which complies with the guidelines EPA has promulgated pursuant to section 7004(b) of the Act (40 CFR Part 249).

(2) Consistency. A State seeking full authorization shall demonstrate the "consistency" of its program with the Federal program or State programs applicable in other States in order for the State program to be authorized. Such States shall satisfy the requirements of both the free movement of hazardous wastes across State boundaries and the degree to which State standards may vary from those of EPA or of other States, except that States which violate these requirements on the date of promulgation of these guidelines may request a temporary suspension of this requirement. The Regional Administrator may grant a temporary suspension of this requirement for a period not to exceed July 1, 1978, upon a showing that the State is working towards elimination of this violation. For purposes of this subpart, the phrase "* * * State programs applicable in other States * * *" refers only to those programs which have received full authorization under section 3006(b) of the Act.

(i) Free movement of hazardous wastes. (A) Any State program which includes a ban on the importation of hazardous wastes from other States which are destined for treatment, storage, or disposal facilities having hazardous waste permits under the State program will be deemed inconsistent for the purposes of section 3006(b).

Therefore, the Regional Administrator shall not grant full authorization to a State program including such a ban.

(B) Any State program which applies one standard to hazardous wastes originating within its borders, and a different standard to hazardous wastes originating elsewhere, will be deemed inconsistent with the Federal program and with those programs applicable in other States. Therefore, the Regional Administrator shall not grant full authorization to such a State program.

(ii) Dissimilar standards. Where the proposed State program includes standards which are significantly different from the Federal standards, the Regional Administrator shall determine whether such State standards substantially impede the movement of hazardous wastes into or out of the State; and whether such State standards protect public health and the environment to substantially the same degree as do the Federal standards. If the Regional Administrator determines that such State standards do substantially impede the movement of hazardous wastes into or out of the State, then the State program is inconsistent for the purposes of section 3006(b), unless such standards protect public health and the environment to substantially the same degree as do the Federal standards. If the Regional Administrator does not authorize a State program due to this determination of inconsistency, the State may continue to operate its hazardous waste program in parallel with the Federal program.

(3) Adequacy of enforcement. A State seeking full authorization shall demonstrate that the enforcement provisions of the proposed State program are adequate, and that the State is able to administer and enforce its program successfully. The Regional Administrator shall consider the proposed State enforcement procedures, practices, and penalties, comparing them with those contained in the Act, and with those implemented by the Environmental Protection Agency for the Federal program in evaluating the adequacy of the State's proposed enforcement program. The Regional Administrator should employ the following criteria in regard to penalty assessment in evaluating the adequacy of enforcement of a State Program that legislation exists authorizing civil and criminal penalties with a deterrent value adequate to handle almost all enforcement actions and that the legislation provides that such penalties be sought in appropriate circumstances.

(b) Partial authorization. The Regional Administrator may authorize a State to administer and enforce selected components of a hazardous waste regulatory program as described in § 250.72(a)(1)(i) while retaining responsibiltity for such part or parts for which State legislative authority is absent. A negotiated Memorandum of Understanding as described in § 250.74(a) is required for partial authorization.

(1) Application. States may apply for partial authorization only if State legislative authority does not exist for certain program components. Partial authorization of the hazardous waste program may only be granted if such components meet the three criteria of equivalency, consistency, and enforceability. In all cases, the combination of the State and EPA hazardous waste program shall meet the substantive and procedural requirements of a full hazardous waste program described in 250.72(a).

(2) Duration. Partial authorization shall be effective for a fixed duration, agreed upon mutually by the State and the Regional Administrator and not to exceed 5 years, and shall apply to complete and discrete components of the program from among those identified in § 250.72(a)(1)(i) of these Guidelines. At the end of the fixed period, the Regional Administrator shall determine whether to renew the partial authorization on the basis of a continued lack of State legislative authority; a good faith effort by the State to procure needed legislation; and a determination by the Regional Administrator that the program can be carried out more effectively by the EPA-State partnership than by EPA alone.

250.73 INTERIM AUTHORIZATION (3006c)

Any State which has in existence a hazardous waste program pursuant to State law prior to July 20, 1978, may request interim authorization to carry out a hazardous waste management program which will be granted if such program is "substantially equivalent" to the Federal program. A negotiated Memorandum of Understanding as described in § 250.74(a) is required for interim authorization. The phrase "* * *in existence" requires that States seeking interim authorization have the legislative authority, effective as of July 20, 1978, to conduct their hazardous waste programs as described in § 250.73(b)(2) of these Guidelines.

(a) Duration. Interim authorization is only effective for the period from October 21, 1978, through October 21, 1980.

(b) Substantial equivalency. A State seeking interim authorization shall submit copies of the relevant legislation to the Regional Administrator together with evidence to demonstrate that the State is willing and able to conduct a successful hazardous waste program, which, at a minimum, complies with § 250.73 (b)(1) through (b)(5).

(1) Authorization plan. A State seeking interim authorization shall submit an "authorization plan" as part of its application. The authorization plan shall describe the additions or modifications necessary to qualify the State program for full authorization under Section 3006(b) by October 21, 1980, together with the schedule which the State proposes to achieve those additions or modifications. Failure to meet the schedule may be cause for withdrawal of interim authorization.

(2) Legislative authority. A State seeking interim authorization shall demonstrate legislative authority to control at least either on-site or off-site hazardous waste disposal facilities, including the authority to conduct inspections and institute enforcement proceedings. Legislative authority to control hazardous waste treatment or storage facilities is not required for interim authorization. The State Authorization Plan shall describe any changes which will be sought in State legislation in order to prepare the state for full authorization as described in § 250.72(a)(1)(i).

(3) Identification of resources. A State seeking interim authorization shall identify and commit adequate resources to carry out the minimal program described in § 250.73 (b)(4) and (b)(5). Evaluation of the resources proposed by the State will be at the discretion of the Regional Administrator. A level of resources which is necessary for the purposes of full authorization will not necessarily be required for interim authorization. The State Authorization Plan shall identify the resource levels which will be applied to hazardous waste management at both the beginning and end of the interim authorization period.

(4) Permit mechanism. A State seeking interim authorization shall demonstrate at a minimum the institutional and administrative capability to issue permits, licenses, letters of approval, or other

control devices to those facilities for which State legislative authority exists. The State Authorization Plan shall describe any changes in the permit system which will be made during the 24-month period for which the interim authorization is effective, to enable the State to become eligible for full authorization.

(5) Surveillance and enforcement. (i) A State seeking interim authorization shall demonstrate a surveillance and enforcement program sufficient to carry out a minimal program as described in § 250.73(b)(5). Evaluation of the surveillance and enforcement program will be at the discretion of the Regional Administrator.

(ii) A surveillance and enforcement effort which is insufficient for full authorization may be sufficient for interim authorization. Where the State proposal provides for a surveillance and enforcement program which does not satisfy the requirements for full authorization, the State Authorization Plan must describe the activities, including those criteria described in § 250.72(a)(3) regarding penalty assessment, through which the State expects to become eligible for full authorization during the twenty-four month period for which the interim authorization is effective.

250.74 FEDERAL OVERSIGHT OF AUTHORIZED PROGRAMS

After all other requirements have been satisfied and before receiving authorization under Section 3006(b) or Section 3006(c) of the Act, the State shall agree with the Regional Administrator on an oversight procedure which will allow EPA to monitor the State's hazardous waste program to ascertain that the program is being administered and enforced successfully in accordance with the Act. The oversight procedures shall become part of the Memorandum of Understanding required under § 250.74(a) of these Guidelines.

(a) Memorandum of Understanding. In order to receive authorization under Section 3006(b) or Section 3006(c) of the Act, a Memorandum of Understanding shall be negotiated between the State and the Regional Administrator. The Memorandum of Understanding shall describe in detail the oversight procedures to which the State and the Regional Administrator have agreed, and may include such other terms, conditions, or agreements as are relevant to the administration and enforcement of the State's hazardous waste regulatory program. At a minimum, the Memorandum of Understanding shall include the items described in § 250.74(a)(1)-(a)(4).

(1) Program evaluation. The State shall allow EPA to review such State records, reports, or files as are relevant to the administration and enforcement of the State hazardous waste regulatory program no less than once in each fiscal year for which the State has received authorization under Section 3006(b) or 3006(c) of the Act. The program review may be scheduled so as to coincide with the annual grant mid-year review.

(2) Review of permit applications. The Memorandum of Understanding shall specify the basis on which the Regional Administrator may select permit applications of the State for review. The

Regional Administrator may review and comment to the State on up to ten (10) percent of the permit applications received by the State in each fiscal year for which the State has received authorization under Section 3006(b) or Section 3006(c) of the Act; the Regional Administrator and the State may agree to a lower percentage limitation where the Regional Administrator believes such an agreement to be useful.

(3) Inspections. The Memorandum of Understanding shall specify the basis on which the Regional Administrator may select facilities within the State where hazardous waste is generated, transported, stored, treated, or disposed for Federal inspection. The Regional Administrator or his designee may conduct inspections of up to ten (10) percent of the generators, transporters, treaters, stopers, and disposers in a State in each fiscal year for which the State has received authorization under Section 3006(b) or Section 3006(c) of the Act. The Regional Administrator and the State may agree to a lower percentage limitation where the Regional Administrator believes such an agreement to be useful. Except in the case of an imminent hazard within the meaning of Section 7003 of the Act, the Regional Administrator shall notify the State at least seven (7) calendar days before each such inspection and allow the State the opportunity to make the initial contact with the facility or site owners or operators. EPA shall give the State the opportunity to lead any inspection or visit conducted by EPA pursuant to this Subpart.

(4) Reports. The Memorandum of Understanding shall specify the frequency and content of such reports as are required to be submitted by the State to EPA, but in no event shall the frequency of such reports be less than once in each quarter of any fiscal year for which the State has received authorization under Section 3006(b) or Section 3006(c) of the Act. The content of such reports shall be specified in the Memorandum of Understanding and may be combined with grant reports where applicable.

(b) Change in oversight requirements. The oversight mechanism outlined above and agreed upon by a State and Region shall be binding on both parties except when the Regional Administrator has reason to believe that the State program is not in compliance with requirements of § 250.72(a) and (b) or § 250.73 and all Subparts thereunder. In such a case, and after notice to the State, the Regional Administrator may institute such oversight procedures as he deems necessary to investigate the situation and, where warranted, to insure a return to compliance.

250.75 APPLICATION PROCEDURE

The State application shall include a narrative description of the State hazardous waste regulatory program. The State application shall provide information sufficient for the Regional Administrator to make a determination on the adequacy of the State's program. At a minimum, the following information shall be submitted: Application describing hazardous waste program as it relates to guidelines (full, partial, and interim authorization); authorization plan describing deficiencies and planned milestones to achieve full authorization (interim authorization).

(a) Public hearing. After preparation of the draft application, the State shall give notice to all interested parties of the State's intention to seek authorization. Public notice shall be such that all interested parties will be given reasonable opportunity to comment on the draft application. Copies of the draft application shall be made available to the public for comment. Upon request, the State shall hold a public hearing to discuss the State's application to conduct the hazardous waste program. All interested parties will be given reasonable opportunity to present written or oral testimony on the State's application at the public hearing.

(b) Submission of application to EPA. After consideration of comments received from the public notice and public hearing, the State shall prepare a completed application, signed by the appropriate State official in charge of the designated lead agency, for submission to the Regional Administrator. (Three (3) copies of the final application shall be submitted.)

(c) Notice and determination of findings. Within 90 days following submission of a completed application for program authorization, the Regional Administrator shall issue a notice as to whether or not he expects such program to be authorized. Within 90 days following such notice and after opportunity for public hearing, the Regional Administrator shall publish his findings as to whether or not the State will be given authorization to operate the hazardous waste regulatory program. Public notice of the hearing, if held, will be such that all interested parties will be given reasonable opportunity to present written and oral testimony on the State's application at the public hearing.

250.76 WITHDRAWL OF AUTHORIZATION

Section 3006(e) of the Act requires the Administrator to withdraw authorization of such State program and establish a Federal program where the Administrator determines, after holding a public hearing, that the State program is not in compliance with the requirements of § 250.72(a) and (b) or § 250.73. A regional Administrator having reason to believe that a State is not administering or enforcing an authorized program in accordance with the Act, shall follow the procedure described in § 250.76(a) through (d).

(a) Notice to State of public hearing. A regional Administrator having reason to believe that a State is not administering or enforcing its authorized program in compliance with the requirements of Section 3006 and this Subpart, shall inform the State by registered mail of the specific areas of alleged noncompliance, and that a public hearing will be held to discuss withdrawal of the State's program as required under Section 3006(e) of the Act. If the State demonstrates to the Regional Administrator within 30 days of such notification that the State program is in compliance, the Regional Administrator shall take no further action toward withdrawal.

(b) Public hearing. Where the Regional Administrator still has reason to believe that the State is not in compliance 30 days after notification, a public hearing shall be scheduled not less than 60 days or more than 75 days following the initial notification date. All interested parties shall be given opportunity to present written and oral testimony on the withdrawal of the State's program at the public hearing.

(c) Notice to State of findings. Where the Regional Administrator determines the State program to be in compliance as a result of written or oral testimony presented at such public hearing, he shall take no further action toward withdrawal. Where he finds the State not to be in compliance, he shall notify the State by registered mail of specific deficiencies in the State program and of necessary remedial activities. Within 90 days of receipt of the above letter, the State shall either carry out the required remedial actions or the Regional Administrator shall withdraw authorization. If the State carries out the remedial actions, the Regional Administrator shall take no further action toward withdrawal.

(d) Transfer plan. Whenever any State chooses to relinquish authorization under Section 3006(b) or Section 3006(c), or whenever any State is required to relinquish such authorization through the withdrawal procedures under this Part, the State shall submit to EPA a plan for the orderly transfer of all information to EPA. Such plan shall be submitted not less than 30 days before the date such transfer is to be effected.

SUBPART G - PRELIMINARY NOTIFICATION OF HAZARDOUS WASTE ACTIVITIES

250.800	Scope and purpose.
250.801	Definitions.
250.810	Limited interim authorization.
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250.800 SCOPE AND PURPOSE

(a) Section 3010 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6930), requires that any person generating or transporting, or owning or operating a facility for treatment, storage, or disposal of hazardous waste, must notify the Administrator or authorized State not later than 90 days after promulgation or revision of regulations under section 3001.

(b) These rules specify in more detail who must file notification of hazardous waste activity, when and where notification must be filed, and what such notification must contain.

(c) In addition, these rules establish the means by which State governments that are developing and/or implementing hazardous waste management programs may receive notification from affected persons within their jurisdictions.

250.801 DEFINITIONS

For the purpose of this part:

(a) The term "disposal of hazardous waste" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

(b) The term "hazardous waste" means any solid waste defined as hazardous under subpart A of this part.

(c) The term "hazardous waste activity" means the handling of hazardous waste via the generation, transportation, treatment, storage, or disposal of any hazardous waste.

(d) The term "hazardous waste generation" means the act or process of producing a hazardous waste.

(e) The term "limited interim authorization" means the authorization given to a State agency by the appropriate EPA Regional Administrator to receive notifications of hazardous waste activities under section 3010 during the 180 days following the promulgation of regulations under section 3001. Such authorization has no effect on whether the State receives interim or full authorization under section 3006.

(f) The term "onsite" means on the same or geographically contiguous property. Two or more pieces of property which are geographically contiguous and are divided by public or private right(s)-of-way are considered a single site.

(g) The term "person" means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, any interstate body, or Federal agency.

(h) The term "place of operation" means a manufacturing, processing, or assembly establishment; a transportation terminal; or a treatment, storage, or disposal facility operated by a person at a single site.

(i) The term "responsible individual" means an individual authorized to sign official documents for and act on behalf of a company or organization.

(j) The term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved material in domestic sewage or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct materials as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

(k) The term "State" means any of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

(l) The term "storage of hazardous waste" means containment, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous waste.

(m) The term "terminal" means the location of transportation facilities such as classification yards, docks, airports, management offices, storage sheds, and freight and passenger stations, where hazardous waste which is being transported may be loaded, unloaded, transferred, or temporarily stored.

(n) The term "treatment of hazardous waste" means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume.

250.810 LIMITED INTERIM AUTHORIZATION

(a) Upon application by a State, an EPA Regional Administrator may grant a State within that region the following authority:

(1) To receive notifications of hazardous waste activity from persons seeking to comply with section 3010 requirements.

(2) To conduct programs supplementary to EPA programs to promote compliance with section 3010 requirements.

(b) Under limited interim authorization, the EPA reserves at least the following authority:

(1) To promulgate regulations pursuant to section 3010.

(2) To enforce preliminary notification regulations.

(c) Under limited interim authorization, States shall not grant exemptions regarding who must file notifications, when notification must be filed, or what information this notification must contain.

(d) A State may receive limited interim authorization only once. All such authorizations end on the date six months after regulations are first promulgated under section 3001 of the act.

250.811 APPLICATION PROCEDURES FOR STATES

(a) States seeking limited interim authorization for section 3010 must make a written application to the appropriate EPA Regional Administrator containing the following items:

(1) A statement of the State's intent to apply for interim or full authorization under section 3006 before or during the 90-day period following the promulgation of the section 3001 regulations.

(2) A plan for implementation by the State, in coordination with the EPA Region, of section 3010 requirements, including plans for informing affected persons of the notification requirements, for furnishing to the EPA names and addresses of persons whom the State reasonably believes have failed to comply with notification regulations and for analyses of the data received from affected persons.

(3) A statement of agreement to maintain files and any information received from notification for 3 years after receipt of notification, and to make available any such notification information to the EPA in accordance with requests from the EPA Regional Administrator.

(4) A plan of implementation by the State, in coordination with the EPA Region, for providing notice to the public and to those prospective permittees identified in the notification process of the

facility permit requirements and of the availability of the facility permit applications forms. The plan shall include provisions for the State's receipt and processing of all permit applications submitted.

(b) States seeking limited interim authorization must file the above written applications not later than sixty (60) calendar days after promulgation of these notification regulations.

250.812 RESPONSIBILITIES AND AUTHORITY OF THE EPA REGIONAL ADMINISTRATOR

(a) The EPA Regional Administrator shall have the authority to grant or withhold limited interim authorization.

(b) The EPA Regional Administrator shall consider each State application for limited interim authorization. If an application does not meet all requirements of 250.811(a) (1) and (3), the Regional Administrator shall not grant limited interim authorization. If the Regional Administrator is not satisfied that the State-proposed plans in 250.811(a) (2) and (4) are adequate for implementation of section 3010, he/she shall withhold limited interim authorization.

(c) If the Regional Administrator determines that a State application is unsatisfactory, he/she shall inform that State in writing of the reasons within 15 working days of receipt of the application. The Regional Administrator may then allow that State to submit another application within 15 working days for EPA consideration.

(d) If the Regional Administrator finds a State application acceptable, he/she shall execute an agreement with that State, signed by the Regional Administrator and an official of the responsible State agency, granting limited interim authorization to implement section 3010 requirements. All such agreements shall be effective no later than 120 calendar days after promulgation of these preliminary notification regulations and shall terminate on the effective date of the section 3001 regulations (6 months after promulgation).

250.820 WHO MUST FILE NOTIFICATION

(a) Every person conducting a hazardous waste activity at the time of promulgation or revision of section 3001 regulations must file notification in accordance with these regulations. This notification constitutes one of the conditions for interim status for all persons who treat, store, and dispose of hazardous waste. Owners of inactive hazardous waste treatment, storage, and disposal facilities are not required to notify. Those persons who must both notify and either seek a generator or a transporter identification code or apply for a new or a revised facility permit pursuant to revision of section 3001 regulations may accomplish notification with either the submission of the information required for the respective identification code, or with the submission of the application for a new or a revised facility permit, provided such information is submitted within the first 90 days after promulgation of the revised section 3001 regulations. Further definition of what is a hazardous waste, who is a generator; who is a transporter; and who is an owner or operator of a treatment, storage or disposal facility is given in regulations promulgated under sections 3001, 3002, 3003, 3004, and 3005 of the act.

(b) Special cases. - (1) Corporations. A responsible individual of the corporation shall file notification.

(i) A group of establishments, plants, transportation terminals, etc., located at a single site under the ownership or operation of one person may file a single notification.

(ii) A person owning and operating more than one place of operation may file a single notification for all facilities provided:

(A) All required information is clearly stated separately for each place of operation, and

(B) Copies of the pertinent information in this single notification are sent to each EPA Regional Office (or authorized State) having jurisdiction over the area in which the places of operation are located.

(2) Highway transporters. A responsible individual shall file notification for each terminal the transporter owns and utilizes for vehicles transporting hazardous wastes.

(3) Railroad or pipeline companies. A responsible individual may file a single notification for the entire rail line or pipeline, provided that copies of this notification are sent to each EPA Regional Office (or authorized State) having jurisdiction over the area in which the railroad or pipeline is located.

(4) Federal agencies conducting hazardous waste activities must comply with all notification requirements in the same manner as other persons.

(5) Federal on-scene coordinators, when acting in their official capacity under the provisions of section 311 of the Federal Water Pollution Control Act, and the national oil and hazardous substance pollution contingency plan, are not included under the requirements of these regulations.

(6) These regulations do not apply to persons who transport hazardous materials which have been spilled.

250.821 WHEN TO FILE NOTIFICATION

(a) Persons conducting hazardous waste activities at the time of promulgation or revision of Section 3001 regulations ("hazardous waste identification and listing") must file notifications not later than ninety (90) days after promulgation or revision of section 3001 regulations.

(b) Any person conducting hazardous waste activities at the time of promulgation or revision of section 3001 regulations who does not file notification of such activity within 90 days of the date of this promulgation or revision is in violation of these notification regulations and may be subject to the penalties described under section 3008 of the act. No hazardous waste may be legally transported, treated, stored, or disposed unless notification has been made. It should be noted that late notification is a violation of section 3010 and subjects such person to possible enforcement action.

250.822 WHERE TO FILE NOTIFICATION

(a) Persons must file notifications with the appropriate EPA Regional Administrator or State which has been granted limited interim authorization. Copies of the pertinent notification information shall be sent to each EPA Regional Administrator or designated State agency in which the person's places of operation are located.

(b) Persons owning or operating several places of operation should refer to 250.820(b).

(c) A list of names and addresses of all State agencies granted the limited interim authorization to receive notifications will be published in the Federal Register before or at the time of promulgation of section 3001 regulations.

250.823 INFORMATION REQUIRED IN NOTIFICATION

(a) If a person fully and accurately completes and returns the form presented in these regulations (see Table I) for each place of operation, the person will have complied with the requirements of 250.823 of these regulations. Persons utilizing this form may submit additional information or documents as a part of the notification submission.

(b) If a person chooses not to use the form, that person must file a written notification stating clearly and legibly the following information (for each place of operation):

(1) The name of the organization and place of operation.

(2) The mailing address and location of the place of operation.

(3) The principal activity of the place of operation, either by four-digit standard industrial classification (SIC) code or by other description (e.g., inorganic chemical manufacturing, petroleum refining, etc.).

(4) An identification number for the place of operation.

(i) If a person has an Internal Revenue Service employer identification number (EIN), this number shall be provided.

(ii) A person who operates more than one place of operation with the same EIN for all shall designate a separate suffix to the EIN to distinguish each place of operation (e.g., (EIN No.)-2, (EIN No.)-3).

(iii) Federal facilities shall provide the General Services Administration agency and facility number.

(iv) Transporters shall provide their Interstate Commerce Commission number; however, if a transporter does not have such a number, he/she shall provide his/her Public Utilities Commission number, or other permit number (as assigned by State Health Department, etc.).

(v) All notifiers shall state the specific sources (IRS, ICC, etc.) of the identification number.

(vi) If a person does not have an already assigned identification number, this fact shall be stated. An identification number will then be assigned by EPA (or the designated State agency).

(5) The name, telephone number, and address of a responsible individual at the place of operation who could be contacted for clarification of information submitted in the notification.

(6) The following statement, with signature, name, title, and date: "I hereby certify that the information provided herein is complete and correct to the best of my knowledge. I understand that all information in this notification may be made available to the public, unless otherwise noted, according to 250.823(b) (10). I am authorized to sign official documents for my organization."

(7) The type(s) of hazardous waste activity conducted by the person, i.e., generation, transportation, treatment, storage, or disposal of hazardous waste. Treatment, storage, or disposal activities conducted at the site of waste generation shall be indicated as "onsite treatment," etc. Persons who transport hazardous waste shall indicate the mode (air, rail, highway, water, etc.) of transportation.

(8) The types of hazardous waste handled by the person, as identified by criteria under section 3001 regulations. All wastes which are ignitable, reactive, infectious, radioactive, or corrosive must be described as such. However, persons who cannot in the 90-day period allowed definitively determine whether their wastes are toxic may so indicate. If, after the 90-day period, it is determined that a waste is non-toxic, a statement to this effect must be filed no later than 180 days after promulgation of section 3001 regulations.

Otherwise, the person will be considered for notification purposes, to be conducting hazardous waste activities. If, at some future date, a person determines that his waste is not hazardous according to section 3001 regulations or if he ceases to handle hazardous waste, he may file a statement to this effect, and he will no longer be considered to be conducting hazardous waste activities under this section.

(9) A description of the hazardous waste handled as identified by listing under the section 3001 regulations or by the general type specified in said regulation and specific contents (where known) using the best available information (e.g., "wastewater treatment sludge containing lead compounds").

(10) A statement indicating what information, if any, in 250.823(b), numbers (8), (9), and (11) (types, description, and quantities of hazardous waste), is to be considered confidential business information. If the information is claimed as confidential, it will be treated in accordance with the confidentiality of business information regulations in 40 CFR Part 2, Subpart B. When reported on the sample form, information that is not claimed by the person filing notification as confidential may be released to the public without further notice to the person who submitted it. The EPA or the designated State agency will make the final determination as to whether information submitted is in fact confidential.

(11) Optional: An estimate of the annual amount of hazardous waste handled based on the period from January 1, 1977, to December 31, 1977. For persons not conducting hazardous waste activities during any or all of that period, the annual volume should be estimated in the best practical manner.

APPENDIX C

CHARACTERIZATION OF POTENTIALLY HAZARDOUS WASTES GENERATED BY SELECTED MANUFACTURING INDUSTRIES

This appendix presents a characterization of potentially hazardous waste streams and waste stream constituents generated by manufacturing processes. Thirteen manufacturing industries which were the subject of a series of EPA contractor studies on industrial hazardous waste practices (Industry Studies, 1975-1978) are used as the basis for this hazardous waste characterization. The industries included in the characterization are as follows:

- Textiles;
- Inorganic chemicals;
- Pharmaceuticals;
- Paint and allied products and contract solvent reclaiming;
- Organic chemicals, pesticides, and explosives;
- Petroleum refining;
- Petroleum re-refining;
- Leather tanning and finishing;
- Metal smelting and refining;
- Electroplating and metal finishing;
- Special machinery manufacturing;
- Electronic components manufacturing;
- Storage and primary batteries.

It should be noted that the characterization of potentially hazardous wastes from each of the selected industries is based upon information reported in the Industry Studies and is only meant to provide an understanding of the various types of potentially hazardous waste streams and waste stream constituents generated by different manufacturing processes; the characterization is not meant to be an all-inclusive delineation of every potentially hazardous waste stream generated by each industry. Furthermore, it is not meant to be implied that all waste streams and waste stream components identified as being potentially hazardous would necessarily be considered hazardous under the Subtitle C regulations. The definition of what constitutes a potentially hazardous waste, as used in each Industry Study, was developed by each individual EPA contractor and varied from one Industry Study to another.

It should also be noted that the Industry Studies considered only land destined wastes (including wastes sent to incineration). Wastes which might be potentially hazardous but which are sent to reclaimers, discharged in wastewater effluents, or disposed by other means were not considered in the studies. Furthermore, the studies identified waste streams as hazardous only if they contained at least one specific component at potentially hazardous levels. Due to data limitations, waste streams which contained no one substance at potentially hazardous levels, but which could still be hazardous based upon the overall toxicity of the entire waste stream or based upon characteristics other than toxicity, were generally not identified as potentially hazardous. The major emphasis of the various studies was placed on identifying wastes containing heavy metals and selected organic compounds; there was much less emphasis on other properties of potentially hazardous wastes. For a detailed discussion of the wastes from each industry and the characteristics used to identify potentially hazardous wastes from each industry, see the individual Industry Studies referenced in each of the following sections.

C.1 Textile Industry

The hazardous waste characterization of the textile industry (SIC Code 22) is based upon information reported by Versar, Inc. (1976). According to that report, potentially hazardous wastes from the textile industry can be grouped into the following five categories:

- Wastewater treatment sludge;
- Dye containers;
- Chemical containers;
- Solvent and still bottom wastes;
- Fiber wet with dye and dye-assist chemicals.

Wastewater treatment sludges from the textile industry contain such potentially hazardous constituents as heavy metals, residual and adsorbed dyestuffs, and chlorinated organics. The bulk of the heavy metals which end up in the wastewater treatment sludges are washed or rinsed from fabric by such operations as scouring of incoming greige goods, cloth dyeing, and application of various finishes. Heavy metals are contained in dyes; catalysts used for the application of wash-and-wear, durable press, and water repellent finishes; compounds used to improve washfastness or lightfastness in certain fabrics; flame retardant finishes; and input fabrics and fibers from application of pesticides or other chemicals. Selected heavy metals identified in wastewater treatment sludges from various industry components include: arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.

Several studies have shown that various dyes which end up in wastewater treatment sludges may be potentially hazardous. Residual and adsorbed dyestuffs, in addition to containing heavy metals, also contain other potentially hazardous constituents such as organic dye carriers. Dye carriers include compounds such as biphenyl, orthophenyl phenol, butyl benzoate, methyl salicylate, trichlorobenzene, and perchloroethylene.

Residual organics other than dyes may also be a potentially hazardous component of textile sludges. While there are a great many organic compounds used in the textile industry, the Versar, Inc. study did not attempt to identify specific organic compounds, except total chlorinated organics, present in textile sludges. The total chlorinated organics present ranged from 0.11 to 64.7 ppm.

Discarded dye containers and chemical containers containing residual dyestuffs and chemicals are a second source of potentially hazardous wastes. Residual dyestuffs may contain previously discussed hazardous constituents. Residual chemicals other than dyes may include such constituents as dichromate salts (oxidizing agents); sodium hydrosulfite (reducing and stripping agent); zinc nitrate and magnesium chloride (catalysts); polyvinyl chloride, tetrakis (hydroxymethyl) phosphonium chloride, chlorinated paraffins, and organic phosphorus compounds (flame retardants); silicofluoride compounds, sodium pentachlorophenate and phenylsulfonic acid derivatives (mothproofing agents); and urea-formaldehyde, dihydroxy-dichlorodiphenylmethane, mixture of zinc salts of dimethyldithiocarbamic acid, 2-mercaptobenzothiazole, and copper naphthalene (mildewicides).

Solvent wastes and still bottoms are isolated and atypical instances of potentially hazardous wastes generated by the textile industry. These wastes generally result from specialized processes that are not common throughout the industry. Some of the solvents used include acetone, butyl carbitol, butyl cellosolve, dioxane, methanol, naphtha, and trichloroethane.

Yarn and fiber wet with non-fixed dye and dye-assist chemicals are another instance of isolated and atypical potentially hazardous wastes. The dye and dye-assist chemicals include those constituents previously discussed.

C.2 Inorganic Chemicals Industry

The hazardous waste characterization for the inorganic chemicals industry (SIC Code 281) is based upon information reported by Versar, Inc. (1975). According to that report, potentially hazardous process wastes are generated by the following three subcategories of the inorganic chemicals industry:

- Alkalies and chlorine production (SIC 2812), (e.g., chlorine, sodium and potassium hydroxides, synthetic soda ash);
- Inorganic pigments production (SIC 2816), (e.g., titanium dioxide pigments, chrome pigments, iron blue);
- Industrial inorganic chemicals not elsewhere classified (SIC 2819), (e.g., sulfuric acid, hydrofluoric acid, alum, sodium sulfide, phosphorus).

Alkalies and chlorine production generates four major types of potentially hazardous process wastes. Mercury contaminated brine purification muds, brine treatment sludges, and solid wastes are generated by the mercury cell process for the production of chlorine and alkalies. Asbestos and lead contaminated wastewater treatment sludges and solid wastes result from the diaphragm cell process for the production of chlorine and alkalies. Chlorinated hydrocarbon wastes are produced by diaphragm cell processes. Explosively reactive or flammable metallic sodium and calcium sludges result from the Down's cell process for producing chlorine and sodium.

Inorganic pigments production generates process wastes containing potentially hazardous levels of heavy metals. Production of titanium dioxide pigments may result in wastewater treatment sludges and slurries containing chromium, vanadium, niobium, and zirconium compounds. Production of white opaque pigments may generate wastewater treatment sludges containing lead and arsenic compounds; furnace slags and dusts containing zinc; and solid wastes containing lead, cadmium, and antimony compounds and salts. Production of chrome colors and other inorganic pigments may result in wastewater treatment sludges and solid wastes containing cadmium, chromium, cyanide, lead, mercury, and zinc compounds.

Production of industrial inorganic chemicals (not elsewhere classified) generates potentially hazardous wastes containing such constituents as cadmium, chromium, cyanide, nickel, mercury, arsenic, fluoride, phosphorus, sodium, and uranium compounds. For example, the production of chromates may generate wastewater treatment sludges, ore residues, and other solid wastes contaminated with chromium; the production of cadmium salts may generate wastewater treatment sludges and dusts containing cadmium; the production of phosphorus may produce wastewater treatment sludges containing colloidal phosphorus and fluoride compounds and furnace slags and dust containing fluorides as well as radioactive materials such as uranium oxide.

C.3 Pharmaceutical Industry

The hazardous waste characterization for the pharmaceutical industry (SIC Codes 2831, 2833 and 2834) is based upon information reported by Arthur D. Little, Inc, (1976b). According to that report, potentially hazardous waste streams are generated by the following three functional sections of the pharmaceutical industry:

- Research and development;
- Production of active ingredients;
- Formulation and packaging.

Research and development has the function of discovering new drugs and developing and improving formulations of new and older drugs. Potentially hazardous wastes from research and development include flammable waste solvents and wastes containing heavy metals, such as mercury and zinc, used in drug formulations. Table C-1 lists typical solvents used by the pharmaceutical industry.

Active ingredients include synthetic organic medicinals (e.g., vitamins and aspirin), inorganic medicinals (e.g., antacids), fermentation products (e.g., antibiotics), botanicals (e.g., alkaloids and steroids), medicinals from animal organs (insulin), and biologicals (e.g., vaccines and blood fractions). Potentially hazardous wastes generated during production of active ingredients include waste solvents, organic chemical residues, contaminated high inert content wastes, and heavy metal wastes.

Table C-2 shows the major types of potentially hazardous wastes generated from each category of active ingredient production and typical constituents of the waste. Organic chemical residues include unreacted raw materials used in the production of synthetic organic medicinals. These residues are separated from the product by methods such as extraction, distillation, precipitation, crystallization, or filtration and may be recovered as still bottoms, chemical muds, or

TABLE C-1

TYPICAL WASTE SOLVENTS GENERATED BY THE PHARMACEUTICAL INDUSTRY*

Acetone
Acetonitrile
Amyl acetate
Benzene
Butanol
Butyl acetate
Chloroform
Ethanol
Ethylene dichloride
Ethylene glycol
Heptane
Isopropyl alcohol
Methanol
Methyl chloride
Methyl isobutyl ketone
Naphtha
Toluene
Xylene

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*Arthur D. Little, Inc., 1976b.

TABLE C-2

TYPICAL POTENTIALLY HAZARDOUS WASTES GENERATED DURING PHARMACEUTICAL ACTIVE INGREDIENT PRODUCTION*

SYNTHETIC ORGANIC MEDICINALS

- Waste Solvents
  - Acetone
  - Toluene
  - Xylene
  - Benzene
  - Isopropyl alcohol
  - Methanol
  - Ethylene dichloride
  - Acetonitrile
- Organic Residues (still bottoms, sludges, polymers, tars)
  - Terpenes
  - Steroids
  - Vitamins
  - Tranquilizers
- Contaminated High Inert Solids
  - Activated Carbon
  - Filter Aid
  - Filter Cloths
- Heavy Metals
  - Copper
  - Mercury
  - Arsenic
  - Selenium
  - Zinc
  - Chromium

INORGANIC MEDICINALS

- Heavy Metals
- Selenium

FERMENTATION PRODUCTS (antibiotics-penicillin, tetracyclines, cephalosporins)

- Purification Solvents
  - Butanol
  - Acetone
  - Ethylene Glycol Monomethyl Ether

TABLE C-2 (Concluded)

Recovery Solvents
    Amyl acetate
    Butanol
    Butyl acetate
    Methylisobutyl ketone

BOTANICALS

Alkaloids (Quinine, Reserpine, Vincristine) from Plant Material
Extraction Solvents
    Methanol
    Acetone
    Ethanol
    Chloroform
    Heptane
    Ethylene Dichloride
Purification Solvents
    Ethylene Dichloride
    Naphtha
    Methylene Chloride
    Benzene
Crude Steroids from Plant Material
    Still bottoms (Soybean Oil Refining Residue)

MEDICINALS FROM ANIMAL ORGANS (Insulin, Heparin)

Solvents
    Ethanol
    Methanol
    Acetone

BIOLOGICALS (Blood Plasma Fractions)

Solvent
    Ethanol
Salts
    Sodium Acetate
    Sodium Chloride
    Sodium Phosphate

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*Arthur D. Little, Inc. 1976b.

tars. The residues may contain potentially hazardous organics such as hydroquinone, pyridine, or oxalic acid. Contaminated high inert content wastes include filter aids, activated carbon, and filter cloth and may contain potentially hazardous constituents such as waste solvents and heavy metals. Heavy metals are used as catalysts, oxidants, reducing agents, and product ingredients.

Formulation and packaging involve preparing dosage forms such as tablets, capsules, liquids, or ointments from the bulk active ingredients. Potentially hazardous wastes from formulation and packaging include contaminated and decomposed active ingredients. Some recalled lots of pharmaceuticals which require disposal may also be potentially hazardous (e.g., mercurial ointments).

C.4 Paint and Allied Products Industry and Contract Solvent Reclaiming Operations

The hazardous waste characterizations for both the paint and allied products industry (SIC Code 285) and contract solvent reclaiming operations are based upon information reported by Wapora, Inc. (1975).

C.4.1 Paint and Allied Products Industry. According to Wapora, Inc., there are five principal sources of potentially hazardous waste generation by the paint and allied products industry:

- Raw materials packaging;
- Water treatment sludges;
- Solids from air pollution control equipment;

- Discarded finished products and spills;
- Wash solvents.

Raw materials packaging itself is not hazardous. The small amounts of pigments and other materials used in paint production that remain in the packaging are, however, potentially hazardous. Table C-3 lists examples of potentially hazardous constituents that may be contained in packaging wastes. These potentially hazardous constituents include organic and inorganic pigments which contain heavy metals such as lead, cadmium, zinc, chromium, and copper. Potentially hazardous solvents used include aliphatic solvents, esters, and ketones. A wide variety of potentially hazardous additives, such as metallic soaps, driers, fungicides, germicides, and mildewicides, are also used in paint manufacture.

Wastewater treatment sludges result from the production of water-thinned paints. Potentially hazardous constituents of the sludges include heavy metals from pigments and mercurials from fungicides and preservatives.

Air pollution control equipment used in paint plants consists primarily of air filters. Potentially hazardous solids from such equipment are primarily pigments containing heavy metals.

Waste products consist of finished products which are not saleable and which cannot be economically reworked into some useful form. They include spoiled batches, spills, unsold warehouse stocks, and retained samples. These waste products contain the potentially hazardous materials listed in Table C-3.

TABLE C-3

SELECTED POTENTIALLY HAZARDOUS WASTE CONSTITUENTS FROM THE PAINT AND ALLIED PRODUCTS INDUSTRY*

PIGMENTS

Basic lead carbonate
Basic white lead silicate
Antimony oxide
Zinc oxide (leaded)
Cadmium lithopone
Cadmium yellow
Molybdata orange
Strontium chromate
Zinc chromate
Phthalocyanine blue
Chrome green
Phthalocyanine green
Copper powders
Cuprous oxides

ADDITIVES

Metallic Soaps

- zinc stearate

Metallic Driers

- cobalt soaps
- lead soaps
- zirconium soaps

Fungicides, Germicides, and Mildewicides

- phenols, halogenated phenols, and their salts
- phenyl mercuric acetate
- phenyl mercuric oleate

Table C-3 (Concluded)

SOLVENTS

Aliphatic Hydrocarbons

- mineral spirits, regular and low odor
- mineral spirits, odorless
- kerosene
- mineral spirits, heavy

Aromatic and Naphthenic Hydrocarbons

- benzene
- toluene
- xylene
- naphtha, high flash

Ketones

- acetone
- methyl ethyl ketone
- methyl isobutyl ketone

Esters

- ethyl acetate
- isopropyl acetate
- normal butyl acetate

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*Wapora, Inc., 1975.

Waste wash solvents consist of water or organic solvents used to clean blending tanks, thinning tanks, and other processing equipment. Water solvents are sent to wastewater treatment. Organic solvents may contain organic sludges and pigments and may be reclaimed either on-site or off-site. On-site reclamation generates potentially hazardous still bottoms containing solvents and heavy metals.

C.4.2 Contract Solvent Reclaiming Operations. According to Wapora, Inc., two major classes of solvents are reprocessed by contract solvent reclaiming operations. The first class consists of halogenated hydrocarbons, such as methylene chloride, trichloroethylene, perchloroethylene, and 1,1,1 trichloroethane, which result from degreasing and metal cleaning operations.

The second class includes a wide range of solvents such as aliphatic hydrocarbons, aromatic and naphthenic hydrocarbons, alcohols, esters, and ketones. These waste solvents are generated by the chemical process industry, solvent manufacture, metal cleaning and coatings industries, printing operations, and paint manufacture. Typical solvents include methanol, isopropanol, methyl ethyl ketone, methyl isobutyl ketone, amyl acetate, butyl acetate, hexane, and benzene.

There is one basic waste stream from the various solvent recovery operations, i.e., still bottoms or sludge. Potentially hazardous constituents in the still bottoms include the base solvent as well as other materials including oils, greases, and metal fines from metal cleaning operations; pigments, extenders, and additives from paint residues; and organic contaminants from chemical processes. If the still bottoms are incinerated on-site, the ash residue, containing heavy metals, becomes the waste stream.

C.5 Organic Chemicals, Pesticides, and Explosives Industries

The hazardous waste characterization for the organic chemicals (SIC Code 286), pesticides (SIC Code 2879), and explosives (SIC Code 2892) industries is based upon information reported by TRW, Inc. (1976). Due to the extremely large number of different products and associated waste streams generated by the organic chemicals, pesticides, and explosives industries, the hazardous waste characterization for these industries is based upon selected processes and selected waste streams within these processes.

Table C-4 presents potentially hazardous components within one selected waste stream for each of 17 selected processes. The listed waste streams have been selected by TRW, Inc. to provide a composite picture of the types of potentially hazardous wastes generated by the organic chemicals, pesticides, and explosives industries.

Table C-5 lists potentially hazardous waste stream components generated within various SIC codes of the organic chemicals and technical pesticides industries.

C.6 Petroleum Refining Industry

The hazardous waste characterization for the petroleum refining industry (SIC Code 2911) is based upon information reported by Jacobs

TABLE C-4

POTENTIALLY HAZARDOUS COMPONENTS OF SELECTED WASTE STREAMS FROM THE ORGANIC CHEMICALS, PESTICIDES, AND EXPLOSIVES INDUSTRIES*

Process product	Selected waste stream	Potentially hazardous components
Perchloroethylene	Nonaqueous liquid heavy ends from perchloroethylene	Hexachlorobutadiene, hexachlorobenzene, chloroethanes, chlorobutadienes, tars and residues
Nitrobenzene	Nonaqueous liquid still heavy ends	Nitrobody heavy ends
Chloromethane solvents	Solid tails from solvent recovery system	Hexachlorobenzene, crude hexachlorobutadiene, and other chlorinated paraffins
Epichlorohydrin	Liquid heavy ends (still bottoms)	1,2,3-trichloropropane, tetrachloropropyl ethers, dichloropropanol (dichlorohydrins), epichlorohydrin, chlorinated, aliphatics and alcohols
Toluene diisocyanate	Centrifuge residue sludge	Lower polyurethane polymers and tars, ferric chloride, waste isocyanates
Vinyl chloride monomer	Liquid heavy ends from still	Halogenated aliphatic hydrocarbons (trichloroethane, tetrachloroethane, dichloroethane) and tars
Methyl methacrylate	Liquid heavy ends from methanol recovery	Lower methacrylate polymers; hydroquinone

TABLE C-4 (Continued)

Process product	Selected waste stream	Potentially hazardous components
Acrylonitrile	Liquid heavy impurities (still bottom)	Higher nitriles and polymers
Maleic anhydride	Sludge and residue (distillation column bottoms)	Maleic anhydride; tars, fumaric acid, and chromogenic compounds
Lead alkyls	Lead sludge from settling basin	Lead carbonate, hydroxide and organic compounds and other organics
Aldrin	Area and equipment washdown	Aldrin
Atrazine	Scrubber spent alkali solution	Cyanuric acid, insoluble residues (e.g., cyamelide), and sodium hydroxide
Trifluralin	Solid spent activated carbon	Trifluralin and related fluroaromatic compounds; solvent and unreacted intermediates
Parathion	Sulfur sludge from chlorinator	Sulfur and organophosphorus compounds
Malathion	Filter cake (semisolid)	Dimethyldithiophosphoric acid; toluene and insoluble reactor products
TNT	Red Water	TNT impurities, organic salts, inorganic salts

TABLE C-4 (Concluded)

Process product	Selected waste stream	Potentially hazardous components
Nitrocellulose	Solids	Contaminated nitrocellulose, nitrocellulose fines

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*TRW, Inc., 1976

TABLE C-5

POTENTIALLY HAZARDOUS WASTE STREAM COMPONENTS BY STANDARD INDUSTRIAL CLASSIFICATION, ORGANIC CHEMICALS AND TECHNICAL PESTICIDES INDUSTRIES*

CYCLIC INTERMEDIATES (SIC 28651)

Aluminum oxide (DPA contaminated catalyst)
Amines
Ammonia
Azobenzene
Benzidine
Benzidine hydrochloride
Chlorinated aromatics
Chlorotoluene and phenol
Cyclopentadiene
Dichloroanilines
Dichloroethane
Dinitrotoluenes
Diphenylamine
Heavy metal catalyst from melamine manufacture
Heavy organics from p-nitroaniline manufacture
Hydrazobenzene
Hydroquinone
Isocyanates
Manganese oxides
Melamine
Methyl aniline
α-naphthylamine
β-naphthylamine
Nitrobenzene sulfonic acid
Nitrotoluene
N-phenylhydroxylamine
N,N-diethylaniline
Phenol
Phenolics
Phenylenediamines
Phosgene
Phthalic anhydride
Polymeric matter, phenol contaminated
Polymers and tarry matter from isocyanates manufacture
p-chlorophenol
p-hydroxybenzoic acid
p-nitroaniline
p-nitrochlorobenzene

TABLE C-5 (Continued)

CYCLIC INTERMEDIATES (SIC 28651)

p-nitrotoluene sulfonic acid
Quinone
Resorcinol, phenol and cresol
Resorcinol
Sodium phenoxide
Spent catalyst and support
Sulfuric acid
Tars from diphenylamine manufacture
Tars and naphthylamine from and naphthylamine manufacture
Toluene diamine
Toluidine
2-naphthylamine
2,4 dimethylaminoazo benzene
3,3'-dichlorobenzidine

SYNTHETIC ORGANIC DYES (SIC 28652)

Aminotoluene
Chloroacetic acid
Dinitrophenol
Phenol
p-anisidine
p-formamidoanisole
p-hydroxyaniline
o-anisidine
o-formamidoanisole
o-hydroxyaniline
o-nitrophenol
2-aminotoluene
2-amino, 4-nitrophenol
2-nitro, 4-aminophenol
2-nitro, 4-amino anisole
2,4-diaminotoluene
4-aminotoluene (paren-toluidine)

SYNTHETIC ORGANIC PIGMENTS, LAKES, TONERS (SIC 28653)

Naphthylamine
N-ethylnaphthylamine
p-toluidine
p-toluidine-2-sulfonic acid
p-toluidine-3-sulfonic acid
3,3'-dichlorobenzidine

TABLE C-5 (Continued)

CYCLIC (COAL TAR) CRUDES (SIC 28655)

Phenols

MISCELLANEOUS CYCLIC (COAL TAR) CHEMICAL PRODUCTS (SIC 28691)

Acetylamino fluorene
Ferric chloride
Naphthenic acid
Naphthenic acid salts
Phenol
Phenolic salts
p-cresol
Thionyl chloride
Zinc dust
2,6 di-tert-butyl-p-cresol

MISCELLANEOUS ACYCLIC CHEMICALS AND CHEMICAL PRODUCTS (SIC 28692)

Acetonitrile
Acrolein
Acrylic acid
Acrylonitrile
Allyl alcohol
Allyl chloride
Ammonia
Ammonium cyanide
Ammonium methacrylate
Antimony oxide
Antimony pentachloride
β-propiolactone
Carbon tetrachloride
Chlorinated aldehydes
Chlorine
Chloroacetic acid
Chloroamino ethanes
Copper (recov) from acetaldehyde manufacture
Crotonaldehyde
Crude hexachlorobenzene
Dichloroethane
Dichloroethylene
Diethylamine
Dimethyl ethers
Epichlorohydrin
Ethyleneamines

TABLE C-5 (Continued)

MISCELLANEOUS ACYCLIC CHEMICALS AND CHEMICAL PRODUCTS (SIC 28692)

Ethylene diamine
Ethylene dichloride
Ethylene oxide
Ethyleneimine
Ethyl acrylate
Fluorocarbons
Heavy ends from acetic anhydride manufacture
Heavy metal catalyst from n-paraffins manufacture
Heavy tars from vinyl chloride manufacture
Hexamethyleneimine
Hydrogen chloride
Hydrogen cyanide
Hydroquinone
Lead sludge
Mercuric tin hydroxide
Metallic fluorinating agent
Methylchloromethylether
Methyl ethyl ketone
Methyl Methacrylate
Mixed heavy chlorinated hydrocarbons
Sodium salt of EDTA
Nickel from hexylene glycol manufacture
Nickel chloride
N-chlorodimethyl amine
N-nitrosodimethyl amine
Phenols
Pentachloroethane
Perchloroethylene
Phenol/aniline
Polymers from acrylic acid/acrylates manufacture
Propionic acid
Propylene oxide
Propyl aldehyde
Sodium acrylate
Sodium cyanide
Sodium fluoride
Sodium formate
Stearic acid
Stearic acid salts
Tars from ethylene diamine manufacture
Tetrachloroethane
Tetrachloroethylene

TABLE C-5 (Continued)

MISCELLANEOUS ACYCLIC CHEMICALS AND CHEMICAL PRODUCTS (SIC 28692)

Trichloroethane
Trichloroethylene
Trichloropropane
Vinyl chloride
Vinyl chloride contaminated solids
Vinylidene chloride
Zinc acetate/on coke
1,1,2-trichloroethane

SYNTHETIC ORGANIC CHEMICALS (SIC 28693)

Alkylated phenol
Benzyl chloride
Dodecylmercaptans
Myristic acid
Myristic acid ester
Organic mercaptan salts
Partial phosphate esters
Phenols
Spent activated carbon from phosphoric acid ester manufacture
Stearic acid and esters
Tars from benzothiazole manufacture
Unreacted phenol

PESTICIDES AND OTHER SYNTHETIC ORGANIC AGRICULTURAL CHEMICALS (SIC 28694)

Acrolein
Aldicarb
Aldrin
Alpha-naphthylthiourea
Arsenic trioxide
Atrazine
Bis(chloromethyl ether)
Chlorinated methyl ethers
Captan
Carbofuran
Carbaryl
Carbophenothion
Chlordane
2,4-Dichlorophenol
2,6-Dichlorophenol

TABLE C-5 (Continued)

PESTICIDES AND OTHER SYNTHETIC ORGANIC AGRICULTURAL CHEMICALS (SIC 28694)

2,2-Dichlorovinyl dimethyl phosphate
Dieldrin
0,0-Diethyl 0-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) phosphorothioate
0,0-Diethyl S-[2-ethylthio)ethyl] phosphorodithioate
Dimethoate
0,0-Dimethyl 0-p-nitrophenyl phosphorothioate
0,0-Dimethyl S-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl methyl] phosphorodithioate
Dimethyl phosphate ester with 3-Hydroxy-N,N-Dimethyl-cis-crotonamide
Dimethyl phosphate of 3-Hydroxy-N-methyl-cis-crotonamide
Dinoseb
Dioxathion
Diphacinone
Diuron
Endothall
Endrin
Ethyl hexanediol
Ethyl thiocarbonate
Ethion
0-Ethyl S-phenyl ethylphosphorodithioate
S-[2-(Ethysulfinyl)ethyl]0-0-Dimethyl phosphorothioate
Heavy carbamate residues
Hydrazine
Hydrogen sulfide
Heptachlor
Malathion
Methomyl
Methyl chloroacetate
Methyl fluoroacetate
Methyl isocyanate
1-Naphthylamine hydrochloride
Nicotine
Phenol
Phenolic resins from 2,4-dichlorophenoxyacetic acid manufacture
Parathion
Polymers and tars, pesticide contaminated from warfarin manufacture

TABLE C-5 (Concluded)

PESTICIDES AND OTHER SYNTHETIC ORGANIC AGRICULTURAL CHEMICALS (SIC 28694)

Phosphamidon
Sodium p-nitrophenolate
Tarry residues, pesticide contaminated from malathion manufacture
Sodium fluoroacetate
Tetraethyl pyrophosphate
2,4,6-trichlorophenol
Toxaphene
Warfarin

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*TRW, Inc., 1976

Engineering Company (1976). According to that report, potentially hazardous wastes from petroleum refining are contained in the following waste streams:

- Crude tank bottoms;
- Leaded or non-leaded tank bottoms;
- API separator sludge;
- Neutralized hydrofluoric (HF) alkylation sludge;
- Kerosene filter clays;
- Once-through cooling water sludge;
- Dissolved air flotation float;
- Slop oil emulsion solids;
- Spent lime from boiler feedwater treatment;
- Cooling tower sludge;
- Exchanger bundle cleaning sludge;
- Waste bio sludge;
- Storm water silt;
- Fluid catalytic cracker (FCC) catalyst fines;
- Coke fines;
- Lube oil filter clays;
- Spent catalysts;
- Chemical precipitation sludge.

Each of these waste streams was analyzed for potentially hazardous levels of the following waste constituents: oil, fourteen trace metals, phenolic compounds, ammonia compounds, fluorides, cyanides, and polynuclear aromatics (limited to benzene-A-pyrene). Table C-6 lists potentially hazardous constituents that may be present in each waste stream.

Crude tank bottoms consist of solid sediment which accumulates at the bottom of the crude oil storage tanks. Contaminants in crude oil tank sludge vary with the type of crude oil as well as with handling and shipping methods employed prior to delivery to the refinery. Settled sludge consists of a mixture of iron rust, clay, sand, water, sediment, and some occluded oil and wax. Usually this mixture is a tightly held emulsion which does not separate on settling.

Leaded or non-leaded tank bottoms consist of solids which settle to the bottom of product tanks, where they remain pending removal. The characteristics of the deposited sludge vary with the type of product stored in the tank.

API separator sludge consists of solids which settle in the API separator during primary wastewater treatment. Refinery API separators are usually connected to the oily water plant sewer. The bottoms may, therefore, contain a mixture of all sewered wastes, such as tank bottoms, boiler blow-down, and de-salter wastes, as well as a certain amount of all chemical elements that enter a refinery.

Neutralized alkylation sludges are produced by both the sulfuric acid and the hydrofluoric acid alkylation processes. In the sulfuric acid alkylation process, the spent acid, which is approximately 80 percent sulfuric acid, is usually placed in storage tanks

TABLE C-6

POTENTIALLY HAZARDOUS CONSTITUENTS OF PETROLEUM REFINING WASTE STREAMS*

Constituent / Waste Stream	Oil	Phenols	Ammonia Salts	Cyanide	Benzene-A-pyrene	Fluorides	Selenium	Arsenic	Mercury	Beryllium	Vanadium	Chromium	Cobalt	Nickel	Copper	Zinc	Silver	Cadmium	Lead	Molybdenum
Crude Tank Bottoms	X	X	X		X			X	X								X	X	X	X
Leaded Tank Bottoms	X	X			X		X	X	X				X	X		X	X	X	X	X
Non-lead Tank Bottoms	X	X	X	X	X		X		X							X	X	X	X	X
API Separator Sludge	X	X	X					X	X			X				X	X	X	X	X
Neutralized HF Alkylation Sludge	X	X	X	X		X	X										X			
Kerosene Filter Clays	X	X	X		X		X										X	X		
Once-through Cooling Water Sludge		X	X				X	X	X								X		X	X
Dissolved Air Flotation Float	X	X	X				X		X								X			
Slop Oil Emulsion Solids	X	X	X				X	X	X			X				X	X		X	X
Spent Lime		X	X														X			
Cooling Tower Sludge		X	X					X				X				X	X	X	X	X
Exchanger Bundle Cooling Sludge	X	X	X		X		X	X	X			X		X				X	X	X
Waste Bio Sludge		X	X						X			X					X	X		X
Storm Water Silt	X	X	X		X		X	X	X			X		X		X	X	X	X	X
FCC Catalyst Fines		X	X								X	X		X			X		X	X
Coke Fines		X	X								X			X			X	X		
Lube Oil Filter Clays	X	X	X		X		X		X								X	X		
Spent Catalyst⁺																				
Chemical Precipitation Sludge⁺																				

*Jacobs Engineering Company, 1976.

⁺Data not available as to potentially hazardous constituents in these waste streams.

prior to shipment to an off-site producer of sulfuric acid. The sludge which accumulates in storage tanks contains polymerized hydrocarbons, tank scale, and sulfuric acid and is removed when the tank is either cleaned or repaired. The sludge is usually neutralized with lime and disposed on land. Unlike the sulfuric acid alkylation process, all spent acid from the hydrofluoric acid process is neutralized with lime (usually spent lime from the boiler feedwater treatment process) producing an insoluble calcium fluoride sludge, which is removed intermittently to final disposal.

Kerosene filter clays and lube oil filter clays result from treatment of products with clay in order to remove impurities. Treatment with fixed bed clay is used to remove color bodies, chemical treatment residues, and traces of moisture from product streams such as gasoline, kerosene, jet fuel, and light fuel oil. Clay is also used to treat lube oils, a process in which the clay is mixed with the oil and subsequently removed with a rotary vacuum filter.

Once-through cooling water sludge results from water sent to primary settling tanks prior to usage for once-through cooling.

In some refineries, following processing by separators, additional oil and solids are removed by the process of dissolved air flotation. The process takes place in a circular tank in which finely divided solids and oil particles are brought to the surface where they are skimmed off for disposal.

Skimmed oil from the API separators is usually pumped into a slop oil tank where the mixture is separated into three fractions--oil, water, and emulsion. The oil is returned for reprocessing and recycled back to the API separator. The slop oil emulsion layer may be disposed of as a sludge, or it may be further treated, i.e., demulsified.

Spent lime from cold or hot lime softening and from the clarification of boiler feed water is continuously discharged, dewatered in a settling basin, and disposed of on land. The quantities and composition of the spent lime sludges are dependent upon the characteristics of the raw makeup water.

Cooling tower sludge contains those solids which settle in the cooling tower basin. Exchanger bundle cleaning sludge contains scale and sediment from heat exchanger bundles. Stormwater silt collects in the stormwater settling basins and contains run-off from the refinery area.

In the process of biological treatment of refinery aqueous waste streams, excess bio sludge is created which, for efficient operation, must be controlled by wasting. The waste bio sludge has a very high water content (99 percent) and is dewatered prior to disposal.

Fluid catalytic cracker (FCC) catalyst is continuously regenerated by burning off the coke formed on the catalyst during the cracking process. Refineries have installed electrostatic precipitators or an equivalent device to remove any catalyst fines which would otherwise be released to the atmosphere with the regenerator flue gas. These catalyst fines are either disposed as solid waste or, in some cases, sold.

Coke which is produced in the course of various refinery operations, such as fluid coking and delayed coking, is sold as solid industrial fuel. Coke fines result from the movement and handling of the coke. Most of the non-volatile metals contained in the crude petroleum are concentrated in the coke and the coke fines.

A number of refinery processes require the use of a fixed-bed catalyst. The catalysts eventually become inactive (viz, six months to three years). Many of these catalysts contain valuable metals which can be recovered economically. Some of these metals, such as platinum and paladium, represent the active catalytic component; others are contaminants in the feed which are adsorbed on the catalyst during use. After the more valuable metals are recovered, spent catalysts are disposed as solid wastes.

Chemical coagulation is used at some refineries to remove suspended matter from aqueous waste streams. The chemical coagulants which are added for this purpose form a gelatinous, porous precipitate in which the suspended matter, both oil and solids, becomes enmeshed. The composition of the chemical precipitation sludge depends upon the type of coagulant used as well as upon the characteristics of the wastewater.

C.7 Petroleum Rerefining Industry

The hazardous waste characterization for the petroleum rerefining industry (SIC Code 2992) is based upon information reported by Swain et al., (1977). According to that study, petroleum rerefining consists of three basic process steps which produce three major waste streams. These process steps and their waste streams are as follows:

- Pretreatment--sludge
- Distillation--process water
- Post treatment--spent clay

In pretreatment, heat and chemicals are generally used to remove unwanted constituents from the waste oil. Distillation, which usually includes mixing of a bleaching clay with the pretreated waste oil, removes low boiling fractions and undesirable constituents, such as color bodies, from the waste oil. In post treatment, the spent clay is removed by filtration; post treatment can also include acid neutralization or other finishing processes.

Sludge is predominantly composed of the products of acid or caustic pretreatment; however, it may also contain storage tank bottoms (which may contain phenols and other water soluble or dispersible compounds), the interface invert emulsion found in the condensed light ends/stripping steam separation, and waste water treatment sludge.

Acid sludge is a black, tar-like material with a strong sulfuric acid odor reflecting its high acid content. It contains most of the metals, polar compounds,* and solids present in the waste oil. All of the materials listed in Table C-7, except caustics, may be contained in acid sludge at potentially hazardous levels.

Caustic sludge is a black viscous material which varies from free flowing to weakly gelatinous and from neutral to alkaline. All of the materials listed in Table C-7, except acid, may be contained in caustic sludge at potentially hazardous levels.

Spent clay from post treatment is a black, oil-compacted material which contains varying percentages of oil (1 to 45 percent by weight, with an average of 19 percent by weight). In addition to the oil, other potentially hazardous materials in the spent clay may include polymers, other polar compounds, and metals not removed during the pretreatment step.

Process water from steam stripping during the distillation step may contain heavy metals (e.g., lead, zinc), phenols, mercaptans, other sulfur compounds, and hexane solubles (oils, polymers, and other polar compounds). The process water is sent to wastewater treatment, and the wastewater treatment sludge is usually combined with the acid or caustic sludge.

C.8 Leather Tanning and Finishing Industry

The hazardous waste characterization for the leather tanning and finishing industry (SIC Code 3111) is based upon information reported by SCS Engineers, Inc. (1976). According to that study, potentially

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*Polar compounds include additives placed in the original oil and compounds formed during the original use of the oil.

TABLE C-7

POTENTIALLY HAZARDOUS MATERIALS CONTAINED IN PETROLEUM RE-REFINING SLUDGE*

Acid (Sulfuric acid)
Ammonia
Arsenic compounds
Cadmium compounds
Caustic (sodium hydroxide, sodium silicate)
Chromium compounds
Copper compounds
Cresol
Iron compounds
Lead compounds
Mercury compounds
Naphthene compounds
Nickel compounds
Oils (includes polymers, other polar compounds, asphaltenes, and petroleum oils)
Zinc compounds

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*Swain et al., 1977.

hazardous wastes from the leather tanning and finishing industry are contained in the following waste streams:*

- Fleshings;
- Trimmings and shavings;
- Buffing dust;
- Finishing residues;
- Finished leather trim;
- Sewer screenings;
- Wastewater treatment sludges.

Fleshing involves the removal of excess flesh and fatty substances from the hide or skin. Except for sheepskin tanneries, fleshing normally occurs prior to tanning, and the wastes consist primarily of animal fat and protein. Fleshing wastes from sheepskin tanneries may contain chromium at potentially hazardous levels (see Table C-8).

Trimming and shaving wastes result when tanned hides are split and shaved to obtain uniform thicknesses or to remove ragged edges. Trimmings and shaving wastes may contain chromium, copper, lead, and zinc at potentially hazardous concentrations (see Table C-8).

Buffing dust is produced when leather is mechanically sanded to remove surface imperfections and to improve the nap. Buffing dusts may contain chromium, copper, lead, and zinc at potentially hazardous concentrations (see Table C-8).

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*The SCS Engineers, Inc. study analyzed tannery wastes for heavy metals, phenols, and pesticides.

TABLE C-8

POTENTIALLY HAZARDOUS TANNERY WASTE CONSTITUENTS*

		Analytical results	
Waste stream	Hazardous constituent†	Mean concentration (wet weight-mg/kg)	Concentration range (wet weight-mg/kg)
Fleshings	Chromium	4,000‡	‡
Trimmings and shavings			
Chrome	Chromium	7,600	2,200-21,000
Unfinished leather	Chromium	16,900	4,600-37,000
	Copper	90	2.3-468
	Lead	120	2.5-476
	Zinc	60	9.1-156
Buffing dust	Chromium	5,700	19-22,000
	Copper	960	29-1,900
	Lead	150	2-924
	Zinc	160	-
Finishing residues	Chromium	3,500	0.45-12,000
	Copper	40	0.35-208
	Lead	8,400	2.5-69,200
	Zinc	150	14-876
	Organic solvents	NA§	NA§
Finished leather trim	Chromium	14,800	1,600-41,000
	Lead	1,000	100-3,300
Sewer screenings	Chromium	2,200	0.27-14,000
	Lead	30	2-110
	Zinc	60	35-128
Wastewater treatment residues (sludges)	Chromium	3,700	0.33-19,400
	Copper	370	0.12-8,400
	Lead	60	0.75-240
	Zinc	50	1.2-147

*SCS Engineers, Inc., 1976.
†Constituents for which analyses were made.
‡Only one sample analyzed.
§NA - not available.

Finishing residues are produced as a result of air pollution control devices which remove particulates and aerosols from the exhaust gases of spray finishing booths and from the general cleaning of finishing equipment. Finishing residues may contain flammable organic solvents as well as chromium, copper, lead, and zinc at potentially hazardous concentrations (see Table C-8).

The finished leather is trimmed prior to packaging and shipping. Trimming wastes may contain chromium and lead at potentially hazardous levels (see Table C-8).

Sewer screenings result when wastewater is screened prior to discharge for further treatment. Sewer screenings may contain chromium, lead, and zinc at potentially hazardous levels (see Table C-8).

Wastewater treatment sludges may contain chromium, copper, lead, and zinc at potentially hazardous levels (see Table C-8).

C.9 Metal Smelting and Refining Industry

The hazardous waste characterization for the metal smelting and refining industry (SIC Code 33) is based upon information reported by Calspan Corporation (1977). According to that report, potentially hazardous wastes from the metal smelting and refining industry consist primarily of wastewater treatment sludges, furnace slags, and dusts.

Table C-9 lists the types of potentially hazardous waste streams generated by the various metal smelting and refining operations. Table C-10 lists the principal hazardous waste constituents

TABLE C-9

POTENTIALLY HAZARDOUS WASTE STREAMS FROM METAL SMELTING AND REFINING*

Metal category	Type of residual[†]
Primary copper, smelting and fire refining	Acid plant sludges Dusts Miscellaneous slurries
Primary copper electrolytic refining	Miscellaneous slurries
Primary lead	Acid plant sludge Sinter scrubber sludge[‡]
Primary zinc, electrolytic	Acid plant sludge[‡] Miscellaneous sludges[‡]
Primary zinc, pyrometallurgical	Acid plant sludge[‡] Retort residue ("blue powder")[‡] Cadmium plant residue
Primary aluminum	Pot line scrubber, sludge[‡] Pot line skimmings[‡] Spent potliners[‡] Cast house dust
Primary antimony, pyrometallurgical	Blast furnace slag
Primary antimony, electrolytic	Anolyte sludge
Primary titanium	Chlorination sludge
Primary tungsten	Digestion residue
Primary tin	Smelting slag
Primary mercury	Condenser wastewater

TABLE C-9 (Concluded)

Metal category	Type of residual†
Iron and steel	Coke oven sludge Waste ammonia liquor Electric furnace dust Electric furnace sludge Primary mill sludge Primary mill scale Continuous caster sludge Continuous caster scale Hot rolling mill sludge Hot rolling mill scale Cold rolling mill sludge Cold rolling mill scale Cold rolling mill pickle liquor Tin plating mill sludge Galvanizing mill sludge Galvanizing mill pickle liquor
Ferromanganese	Sludge
Silicomanganese	Sludge
Ferrochrome	Dust
Ferronickel	Skull plant tailings Sludge

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*Calspan Corporation, 1977.

†Residuals immediately recycled to process (e.g., dusts) are not included.

‡May be recycled after storage periods of months to years.

TABLE C-10

POTENTIALLY HAZARDOUS WASTE CONSTITUENTS GENERATED BY METAL SMELTING AND REFINING INDUSTRY*

Industry category	Principal hazardous waste constituents
Iron and steel	Heavy metals chromium copper lead nickel zinc Fluorines Cyanides Phenols Oil and grease
Ferroalloys	Heavy metals cadmium chromium cobalt copper lead nickel zinc
Iron and steel foundries	Heavy metals cadmium chromium copper lead nickel zinc
Primary copper smelting and fire refining	Heavy metals antimony arsenic cadmium chromium copper lead mercury nickel selenium zinc

TABLE C-10 (Continued)

Industry category	Principal hazardous waste constituents
Primary copper electrolytic refining	Heavy metals antimony arsenic cadmium chromium copper lead mercury nickel selenium zinc
Primary lead smelting and refining	Heavy metals antimony arsenic cadmium chromium copper lead mercury zinc
Primary electrolytic zinc smelting and refining	Heavy metals arsenic cadmium chromium copper lead mercury selenium zinc
Primary pyrometallurgical zinc smelting and refining	Heavy metals arsenic cadmium chromium copper lead mercury selenium zinc

TABLE C-10 (Continued)

Industry category	Principal hazardous waste constituents
Primary aluminum	Heavy metals copper lead Fluorides Cyanides
Primary antimony	Heavy metals antimony copper lead zinc
Primary mercury	Heavy metals antimony chromium copper lead mercury nickel zinc
Primary titanium	Heavy metals chromium titanium vanadium Chlorides
Primary tungsten	Heavy metals arsenic copper lead zinc
Secondary copper	Heavy metals copper lead nickel tin zinc

TABLE C-10 (Concluded)

Industry category	Principal hazardous waste constituents
Secondary lead	Heavy metals antimony chromium copper lead tin zinc
Secondary aluminum	Heavy metals chromium copper lead zinc High salt slag sodium potassium chloride

*Calspan Corporation, 1977.

in waste streams from the various industry categories. The principal hazardous waste constituents include heavy metals, fluorines, fluorides, chlorides, cyanides, phenols, oils, and grease.

C.10 Electroplating and Metal Finishing Industries

The hazardous waste characterization for the electroplating and metal finishing industries (SIC Code 3471) is based upon information reported by Battelle Columbus Laboratories (1976). According to that report, four types of potentially hazardous wastes are generated by the electroplating and manufacturing industries:

- Water treatment sludges;
- Process waste;
- Degreaser sludges;
- Salt precipitates.

The major sources of water treatment sludges include rinse waters from each plating step as well as spent preplating and postplating solutions. Process solution dragout from the workpieces, as they are moved from tank to tank in plating operations, is rinsed in continuously flowing water.

The rinse waters contain alkalies, acids with dissolved metals, and possibly cyanides from the preplating steps. The metal or metals being plated onto the workpieces appear as dissolved salts in the rinse waters following metal deposition steps. Also present are conductivity salts and additives which were introduced to enhance electrodeposition or the properties of the deposits. Some plating processes incorporate a postplating step intended to alter the metal surface by conversion or filming to improve the corrosion properties of the deposits. Dragouts from these solutions also contain metals and chemicals.

In addition, preplating and postplating solutions are dumped as spent baths into the water of the wastewater treatment system. Such solutions include alkaline soak and electrolytic cleaners; acid and cyanide dips; pickles; descaling baths; chemical and electrochemical polishing baths; and oxidizing, phosphating, coloring, and conversion coating solutions.*

Process wastes can be separated into two distinct categories, i.e., preplating and postplating preparation wastes and miscellaneous wastes. Preplating and postplating preparation wastes include grinding, polishing, buffing, brushing, and abrasive blasting wastes. Potentially hazardous constituents of these wastes include heavy metal particulates, metal ions, lubricants, and buffing compounds.

Miscellaneous process wastes include metallics from used anodes, plating racks, and rejects as well as such non-metallics as filter cakes, worn tank linings, woven anode bags, coatings on plating racks, anode sludges, oils from wastewater treatment, and chemical containers. The non-metallic wastes may contain occluded or absorbed process chemicals and other potentially hazardous wastes such as heavy metals, acid and alkaline cleaning compounds, plating salts, organic additives, solvents, cyanides, and paints.

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*See Section C.11 for a more detailed discussion of specific constituents that may be present in electroplating wastewater streams.

Degreaser sludges arise from reclaiming of both chlorinated hydrocarbons, used to remove grease and oil from mechanically finished parts by polishing and buffing, and combinations of organic chemicals, such as toluene, xylene, acetone, and methylene chloride, used for paint stripping. These sludges contain heavy metals, dissolved greases and oils, buffing compounds, abrasives, paint pigments, and organic solvents.

Salt precipitates from electroless nickel plating operations are produced during the regeneration of the bath composed of calcium orthophosphite and calcium sulfate. This particular type of waste may not always be present because electroless nickel plating operations are not as common as electroplating and/or because small volume solutions are not regenerated.

C.11 Special Machinery Manufacturing Industries

The hazardous waste characterization for the special machinery manufacturing industries (SIC Codes 355 and 357) is based upon information reported by Wapora, Inc. (1977). According to that study, potentially hazardous wastes from the special machinery manufacturing industries are contained in the following major waste streams:

- Heat treating;
- Electroplating;

- Machining*;
- Coating.

Heat treatment of metals is the process of heating and cooling of a solid metal or alloy to obtain desired conditions or properties. Potentially hazardous components in the waste stream from heat treating include metal salts, quenching materials (oil, water, molten metal salts, brine), coolants, solvents, alkaline and acid cleaners, and still bottoms generated in reclaiming spent solvents. These potentially hazardous components may be present separately or, more likely, in combination in the waste stream. For example, waste quenching oils may contain metal salts, cyanide salts, and solvents as well as potentially hazardous additives, such as barium sulfonate, originally present in the oil. Table C-11 lists typical constituents of these waste components.

Electroplating is a process in which an adherent metallic coating in the form of an electrolyte (aqueous solution of acids, bases, or salts) is electrodeposited on the object being plated to obtain a surface with properties or dimensions different from those of the basis metal. Potentially hazardous components in the waste stream from electroplating include acid and alkaline cleaners, solvents, and plating solutions containing heavy metals and cyanides. Table C-11 lists typical constituents of these waste components. Each of these

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*Potentially hazardous waste streams from stamping, blanking and forming operations, from plate and structural fabrication, and from assembly operations are similar to those from machining and are not discussed separately in this section.

TABLE C-11

TYPICAL CONSTITUENTS OF POTENTIALLY HAZARDOUS WASTE STREAMS IN THE SPECIAL MACHINERY MANUFACTURING INDUSTRIES*

OIL AND OIL ADDITIVES

Hydraulic Oils
- rust inhibitors (imidazolines)
- oxidation inhibitors (zinc dithiophosphate)
- corrosion inhibitors (metal dithiophosphates)
- foam inhibitors (silicones)

Lubricating Oils
- detergents (barium sulfonate)
- wetting agents (tri-o-cresyl)
- adherence agents (oleic acid)

Cutting and Coolant Oils
- bactericides
- chlorinated fats
- sulfochlorinated fats
- corrosion inhibitors
- foaming inhibitors

Quenching Oils
- barium sulfonate
- zinc dithiophosphate
- sodium nitrate
- antimony trioxide

METALS AND METAL COMPONENTS

Metal Salts (heat treating)
- sodium cyanide
- potassium cyanide
- barium chloride

Plating Solutions
- nickel sulfate
- chromic acid
- copper cyanide
- cadmium oxide
- zinc cyanide
- silver cyanide
- sodium stannate

TABLE C-11 (Concluded)

METALS AND METAL COMPONENTS (Continued)

Structural Metals Particles
- chromium
- copper
- nickel
- tin
- zinc

ACID AND ALKALINE CLEANERS

Acid Cleaners
- sulfuric acid
- nitric acid
- phosphoric acid
- chromic acid
- fluoboric acid
- hydrochloric acid

Alkaline Cleaners
- sodium hydroxide
- potassium hydroxide
- trisodium phosphate
- sodium cyanide

ORGANIC SOLVENTS

Aliphatic Hydrocarbons
- kerosene
- naphtha

Chorinated Hydrocarbons
- methylene chloride
- trichloroethylene
- perchloroethylene

Alcohol
- ethanol
- methanol

Other
- acetone
- toluene

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*Wapora, Inc., 1977.

waste components may contain additional potentially hazardous materials. For example, alkaline cleaners may contain oil, grease, pigmented drawing compounds, metal chips, cutting fluids, polishing and buffing compounds, and scale. Electroplating wastes are generally in liquid form and the various streams may be combined or kept separate. Sludges containing heavy metals, such as cadmium, chromium, copper, lead, nickel, and zinc, are generated by wastewater treatment of electroplating wastes.

Machining is the removal of material in the form of chips from metal parts, usually through the use of a machine tool. Potentially hazardous components in the waste stream from machining include cutting and cooking oils, solvents, and heavy metals mixed with cutting oils (swarf). Table C-11 lists constituents of these waste components.

Coating involves the application of paint and other types of organic materials to metal surfaces. Potentially hazardous components in the waste stream from coating include paints, solvents, and acid and alkaline cleaners. Paint wastes may contain potentially hazardous constituents such as pigments, resins, oils, solvents, plasticizers, metal organic soaps, non-metallic driers, bactericides, and fungicides.* Table C-11 lists constituents of solvent and cleaning wastes. Cleaning wastes may also contain residues of the materials removed from the surface of the metal, such as oil, phosphate, chromic acid, waxes, inks, carbon black, and heavy metal particles. Wastewater treatment of the coating waste stream generates sludges containing heavy metals such as cadmium, chromium, copper, lead, and zinc.

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*See Section C.4 for a more detailed discussion of potentially hazardous paint wastes.

C.12 Electronic Components Manufacturing Industry

The hazardous waste characterization for the electronic components manufacturing industry (SIC Code 367) is based upon information reported by Wapora, Inc. (1977a). According to that study, due to the degree of design diversity within product areas of the electronic components manufacturing industry, waste streams are characterized according to the general chemical nature of process wastes rather than by manufacturing process. The following categories of process wastes were identified as being potentially hazardous:

- Halogenated solvents;
- Non-halogenated solvents;
- Wastewater treatment sludges;
- Oils;
- Paint wastes;
- Metal scrap;
- Concentrated cyanides;
- Concentrated acids or alkalies;
- Miscellaneous.

The halogenated solvent waste stream includes waste halogenated solvents as well as still bottoms from in-plant solvent distillation and exhibits a wide range in the degree of contamination by other materials. The still bottoms, for example, may contain a high concentration of oils, soldering flux, metal particles, non-metal particles, and metal ions. Heavy metals in the waste may include lead and zinc. Potentially hazardous solvent waste constituents may include trichloroethylene, 1,1,1-trichloroethane, perchloroethylene, freon, and methylene chloride.

The non-halogenated solvent waste stream also shows a wide range in the degree of contamination by other materials. Contaminants include heavy metals such as chromium, lead, and zinc. The non-halogenated solvents used by the industry have, with few exceptions, flash points below 100 F. Potentially hazardous waste constituents include acetone, methanol, methyl ethyl ketone, and xylene.

Wastewater treatment sludges contain three categories of potentially hazardous constituents: particulates, primarily as metal oxides and metal salts; metal ions, including all of the metals used for plating* as well as common metals such as lead, zinc, and iron; and fluorides such as fluoride ions or silico-fluorides from silicon wafer and glass etching.

Waste oils consist of hydraulic, lubricating, and cutting oils and oil slurries. The waste oils are all petroleum distillates and contain contaminants such as heavy metals and additives.†

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*See Sections C.10 and C.11 for a more detailed discussion of electroplating wastes.

†See Section C.11 for a more detailed discussion of waste oil constituents.

The paint waste stream consists of waste paint as well as air filters from spray painting operations, solvent and paint soiled rags, and solvents used for paint clean up. Paint wastes may contain potentially hazardous constituents such as pigments, resins, oils, solvents, plasticizers, metal organic soaps, bactericides, and fungicides*.

Metal scrap, concentrated cyanide, and concentrated acid or alkaline wastes would have many of the same constituents as similar wastes from the special machinery manufacturing (see Section C.11). According to Wapora, Inc., these three waste streams are not generally disposed by the electronic components manufacturing industry. Metal scrap, except beryllium oxide, is usually sold to metal reclaimers. The cyanides, acids, and alkaline wastes are typically oxidized and neutralized by wastewater treatment.

C.13 Storage and Primary Batteries Industries

The hazardous waste characterization for the storage (SIC Code 3691) and primary (SIC Code 3692) batteries industries is based upon information reported by Versar, Inc. (1975a). According to that report, the two different categories of battery production (storage and primary) produce hazardous waste streams which vary greatly in nature. The potentially hazardous constituents within each of the waste streams also vary according to the type of battery being produced.

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*See Sections C.4 and C.11 for a more detailed discussion of potentially hazardous constituents of paint wastes.

Hazardous wastes from the storage battery industry consist largely of sludges from treatment of wastewater streams along with a much lesser amount of rejected and scrap batteries and components. Wastewater streams are generated by electrolytic forming processes and by washing and rinsing steps in the storage battery production. These wastewater streams contain heavy metals and the various electrolytic solutions. Quality control practices lead to the rejecting of cells, plates, and entire batteries which contain heavy metals and their compounds. Scrap and waste materials from the storage battery production also contain heavy metals and their compounds. Table C-12 shows typical waste streams and hazardous constituents within the waste streams for the four major types of storage batteries produced.

Hazardous wastes from the primary battery industry consist almost exclusively of batteries and cells rejected during quality control operations. These rejected and scrap cells and batteries contain heavy metals and their compounds. For a few types of primary batteries, wastewater streams are also produced; however, for the most part, primary battery production can be characterized as not using process water in the production operation. Sludges from applicable wastewater treatment contain heavy metals. Table C-13 shows typical waste streams and hazardous constituents for nine types of primary battery production.

TABLE C-12

POTENTIALLY HAZARDOUS WASTE STREAMS FROM THE PRODUCTION OF STORAGE BATTERIES*

Battery type	Waste stream and hazardous constituents	Typical waste stream composition
Lead-acid	Wastewater effluent treatment sludges containing suspended lead, lead sulfate, and lead hydroxide or calcium sulfate sludge containing lead.†	Sludge - 80% solids containing lead hydroxide and lead sulfate Sludge - 35% solids containing calcium sulfate
	Rejected and scrap grids, pastes and plates containing lead and its compounds.	NA‡
Nickel-cadmium	Wastewater effluent treatment sludges containing cadmium hydroxide and nickel hydroxide.	Sludge - 35% solids composed of 35% nickel hydroxide and 65% calcium hydroxide
	Rejected and scrap cells containing cadmium and nickel and their compounds.	12% nickel, 43% cadmium
Cadmium-silver oxide	Wastewater effluent treatment sludges containing cadmium hydroxide and silver oxide (reclaimed).	NA‡

TABLE C-12 (Concluded)

Battery type	Waste stream and hazardous constituents	Typical waste stream composition
	Rejected and scrap cells containing cadmium and silver oxide (reclaimed).	NA‡
Zinc-silver oxide	Rejected and scrap cells containing zinc oxide-hydroxide, silver oxide, and mercury (reclaimed).	NA‡

*Versar, Inc., 1975a.

†According to industry sources, all rejected and scrap wastes are recovered and sent to lead smelters for processing as secondary lead.

‡NA - not available.

TABLE C-13

POTENTIALLY HAZARDOUS WASTE STREAMS FROM THE PRODUCTION OF PRIMARY BATTERIES*

Battery type	Waste stream and hazardous constituents	Typical waste stream composition
Carbon-zinc	Rejected and scrap batteries containing mercury, zinc, cadmium, and lead.	1% mercury 19% zinc 2.5% zinc chloride >1% lead >1% cadmium
Carbon-zinc air cell	Rejected and scrap batteries containing mercury and zinc.	0.1% mercury 30% zinc
Alkaline-manganese	Rejected and scrap batteries containing mercury and zinc.	1% mercury 16% zinc
Mercury	Scrap batteries and furnace residue containing mercury and zinc.	1% mercury 56% zinc
Weston mercury cell	Rejected and scrap batteries containing mercury, mercuric sulfate, and cadmium sulfate.	18.5% mercury 6.2% mercuric sulfate 7.9% cadmium sulfate 4.4% cadmium
Magnesium-carbon	Wastewater effluent treatment sludges containing trivalent chromium carbonate hydroxide.	Sludge - 50% solids
Zinc-silver oxide	Rejected and scrap batteries containing zinc, silver, and mercury	NA†

TABLE C-13 (Concluded)

Battery type	Waste stream and hazardous constituents	Typical waste stream composition
Lead acid reserve	Rejected and scrap batteries containing lead and nickel.	55% lead 31% nickel
	Wastewater effluent treatment sludges containing lead and nickel.	Sludge - 35% solids composed of 26% lead hydroxide and 74% nickel hydroxide
Magnesium reserve cells	Wastewater effluent treatment sludges containing nickel and lead.	NA†
	Rejected and scrap batteries containing silver chloride (reclaimed) or copper chloride.	NA†

* Versar, Inc., 1975a.
† NA - not available

APPENDIX D

TREATMENT AND DISPOSAL OF HAZARDOUS WASTES

This appendix describes typical methods and practices used in the treatment and/or disposal of hazardous wastes. General treatment and disposal methods are first discussed along with the type of waste amenable to treatment or disposal by each method. Where available data permit, estimates of the quantity of hazardous waste treated or disposed by each method are presented. Following this discussion, existing hazardous waste treatment and disposal practices are characterized for the thirteen manufacturing industries discussed in Appendix C.

D.1 Treatment Methods

The treatment of hazardous wastes is directed toward separating the hazardous components from the non-hazardous components of the waste stream, concentrating the hazardous wastes, rendering the wastes less hazardous, reducing the volume of waste requiring ultimate disposal, and/or recovering and reclaiming materials or energy from the waste. There are four basic types of methods typically used for the treatment of hazardous wastes. These are:

- Physical treatment;
- Chemical treatment;
- Biological treatment;
- Thermal treatment.

Treatment of a hazardous waste is at times limited to the application of just one of the above methods. However, in many instances, especially in the case of wastewater treatment or resource recovery, several of the methods are used in the course of treating the waste (resource recovery is discussed in Appendix E).

It should be noted that the treatment of hazardous wastes using the above methods does not typically constitute ultimate disposal of the waste. Treatment generally produces a residual (e.g., sludge, ash, still bottom, concentrated waste) which may be hazardous and which is typically disposed using the methods described in Section D.2. For example, many of the various physical, chemical, and biological treatment methods are used as part of primary, secondary, or tertiary wastewater treatment and produce a sludge which is potentially hazardous (see Appendix C) and which is disposed as discussed in Section D.3.

D.1.1 Physical Treatment. Physical treatments are used to remove soluble and suspended constituents from aqueous waste streams and to concentrate various constituents of the waste stream. The physical treatment methods in widespread use include: carbon sorption, stripping processes, filtration, gravity separation, flocculation, and evaporation.

D.1.1.1 Carbon Sorption. In carbon sorption, the waste solution is brought into contact with solid carbon, and solute particles are either absorbed or adsorbed by the carbon. The amount of sorbate held by a given quantity of carbon depends upon the surface to volume ratio of the carbon and the intensity of any attractive forces between the two. Carbon sorption can remove organic wastes, heavy metals, and other inorganics from water. Short-chain polar molecules such as methanol, formic acid, and acetone have low removal efficiencies by carbon (Office of Solid Waste Management Programs, 1974a). The greatest applicability of carbon sorption is in processing waste streams which are not amenable to biological treatment because of their content of toxic chemicals and/or the refractory nature of their organic constituents (TRW, Inc., 1976).

In some applications, the ultimate disposal of the sorbate is accomplished as part of the thermal reactivation of the spent carbon by heating the spent carbon in a multiple hearth furnace or rotary kiln; the sorbate is destroyed by pyrolysis/oxidation in the process (Cheremisinoff, 1975; TRW, Inc., 1976). In other applications (e.g., processing of the brine wastewater from trifluralin manufacture), the spent carbon is containerized and placed in storage (TRW, Inc., 1976).

D.1.1.2 Stripping Processes. Stripping processes are used to remove volatile materials from liquid streams. These processes are generally employed to remove relatively small quantities of volatile pollutants from large volumes of wastewater. Stripping is essentially a low-temperature distillation process in which reduction of effective vapor pressure by the introduction of the stripping medium replaces the high temperature requirement. The two types of stripping agents commonly used are steam and inert gas.

The stripping of hydrogen sulfide and ammonia from sour water is probably the most common use of stripping employed by the petrochemical industry for waste treatment. The major stripping agents used to remove these contaminants are steam, natural gas, and flue gas. Phenols can be removed from aqueous waste streams by steam stripping when a wastewater is subject to short variations in temperature, specific gravity, phenol concentrations, and suspended solids. Some volatile organic compounds can be stripped from aqueous wastes by using air as the stripping agent (Booz-Allen Applied Research, Inc., 1973).

D.1.1.3 Filtration. Filtration involves the separation of the solid and liquid phases of aqueous slurry by means of a porous medium. The filtration is accomplished by forcing the aqueous slurry through the filter medium--retaining screens, cloths, or particulates such as sand, gravel, or diatomaceous earth--using gravity, pressure, or a vacuum as the driving force (Versar, Inc., 1975; Powers, 1976). Particles that are larger than the pore size of the filter medium build up as a cake on the filter and have to be removed periodically. The capacity of the process is determined by the flow rate of the filtrate through the filter cake (Office of Solid Waste Management Programs, 1974). Filtration is used for applications ranging from dewatering of sludges to removal of the last traces of suspended solids to give clear filtrates (Versar, Inc., 1975).

D.1.1.4 Gravity Separation. Gravity separation includes both the removal by flotation of materials less dense than water, such as oils and air-entrained particulates, and the removal by sedimentation of suspended materials that are more dense than water. Sedimentation and flotation techniques commonly employ chemical conditioners to enhance the separation process (Booz-Allen Applied Research, Inc., 1973).

Sedimentation. In sedimentation, a waste-containing aqueous suspension is placed in a tank, lagoon, or basin and the suspended particles allowed to settle out; the fluid left above the solid bed may then be removed. If the process is continued long enough, a packed bed similar to a filter cake results (Office of Solid Waste Management Programs, 1974a). In order to hasten the process, sedimentation has been used in conjunction with centrifugal force in large centrifuges (Powers, 1976).

Flotation. Flotation consists of both natural flotation and air flotation. In natural flotation substances lighter than water (e.g., oil and grease) tend to rise naturally to the surface of still wastewaters where they are skimmed off. In air flotation, air is dissolved in the wastewater using pressure, diffusion, or mechanical dispersion. When the wastewater is exposed to a vacuum or to the atmosphere when pressure is used), air bubbles are released which carry suspended materials to the surface where they are held by the air bubbles and flotation reagents (Fair et al., 1968).

D.1.1.5 Flocculation. Flocculation is used when it is difficult to separate suspended waste particles from their liquid medium. Particles in this category include those in the low and fractional micrometer size range since they settle too slowly for sedimentation or centrifugation and may be difficult to filter. With the aid of flocculating chemicals (e.g., alum, ferric chloride, poly electrolytes), these particles can be aggregated and removed (Office of Solid Waste Management programs, 1974a).

D.1.1.6 Evaporation. Evaporation ponds (lagoons) are used for the containment/disposal of liquid wastes, primarily by solar evaporation. Depending on the wastewater volume, evaporation ponds consist of small concrete tanks, large earthen depressions, or basins. To increase the rate of evaporation, some ponds have mechanical surface aerators or sprayers. Evaporation is most successful in areas with high rates of evaporation, low annual rainfall, and a relatively warm climate. In addition to the loss of water by evaporation, and depending on wastewater characteristics, a number of other treatment processes may also be carried on concurrently in an evaporation pond. These processes include sedimentation, biochemical oxidation, precipitation, and chemical oxidation (TRW, Inc., 1976).

D.1.2 Chemical Treatment. Chemical treatments are used to alter the molecular structure of hazardous wastes so as to render them less hazardous or to separate specific constituents of the hazardous waste stream. Chemical treatment methods in widespread use include: neutralization, precipitation, oxidation, reduction, ion exchange, and chemical fixation.

D.1.2.1 Neutralization. Neutralization is the process by which acids and caustic wastes are reacted either with each other or with other acids or caustics to form neutral salts. The resulting salts are usually less hazardous than either of the reactants; the resultant salt may also be insoluble and precipitate from the solution (Versar, Inc., 1977). Neutralization methods include: mixing to achieve a near-neutral pH, passing acid wastes over limestone, mixing acids with lime slurries, adding soda ash to acid wastewaters, blowing waste boiler-flue gas through alkaline wastes, adding compressed carbon dioxide to alkaline wastes, and adding sulfuric acid to alkaline wastes (Versar, Inc., 1975). Neutralization is commonly used in wastewater treatment.

D.1.2.2 Precipitation. Precipitation is used to remove heavy metals and other soluble chemicals from waste streams. The waste stream is reacted with a chemical which causes the formation of an insoluble or precipitated product that can be removed by sedimentation, centrifugation, or filtration. In the battery industry, for example, lime and sodium hydroxide cause lead and nickel to precipitate out of the acidic wastewater (Versar, 1975a). Precipitation reactions tend to generate heavy suspended solid loads.

D.1.2.3 Oxidation. Oxidation processes are used to treat both organic and inorganic waste streams containing strong reducing agents in order to convert these waste streams to a less hazardous state. Oxidation may be achieved using oxygen, chlorine, hypochlorites, ozone, peroxides, or other common chemicals as the oxidizing agent. Chlorine oxidation is commonly used in treating cyanide-containing wastes (Office of Solid Waste Management Programs, 1974a). Wet oxidation, in which organic materials in a liquid state are oxidized under high pressure at moderate temperatures (see heat treatment methods), is used in the pharmaceutical industry when incineration is not feasible (Arthur D. Little, Inc., 1976b). Oxidation processes are exothermic and may allow for energy recovery in some instances (Powers, 1976).

D.1.2.4 Reduction. Reduction processes are used to treat both organic and inorganic waste streams containing strong oxidizing agents in order to convert these waste streams to a less hazardous state. Reduction may be achieved by using sulfur dioxide, sulfite salts, ferrous sulfate, or other chemicals as the reducing agent. For example, in the leather tanning and finishing industries, hexavalent chromium is typically reduced to the less hazardous trivalent form with sulfur dioxide or bisulfites (SCS Engineers, Inc., 1976).

D.1.2.5 Ion Exchange. Ion exchange involves the use of a packed bed of resin to selectively collect anions or cations from solution. Wastewater is passed over the resin until all exchange sites in the resin are placed; then the resin is regenerated and re-used. In the metal finishing industry, for example, the ion exchange method is used to remove waste chromic acid from rinse water. When the resin is saturated with chromate, it is regenerated using a sodium hydroxide solution. The regenerated sodium chromate is passed through a cation exchanger to yield chromic acid, which can be re-used in the plating operation (Crumpler, 1977).

D.1.2.6 Chemical Fixation. Chemical fixation involves mixing hazardous wastes, primarily sludges, with inorganic chemicals and catalysts to tie up hazardous components, thus reducing leachability and rendering the waste less hazardous. There are a number of such processes which produce solids ranging from crumbly soil-like materials to concrete and ceramic slags (Versar, 1975).

D.1.3 Biological Treatment. Biological treatment involves the use of microorganisms to remove organic materials present in wastewater by adsorption and direct metabolism. The degradation rate of an organic compound is a function of the molecular structure of the compound, the genera and species of microorganisms utilizing it as a food source, and the time required for the microorganism to develop the enzymes necessary for substrate utilization. While there are much contradictory data relating the molecular structure of a compound to its biodegradability, the amenability or resistance of certain groups of organic compounds to biological oxidation is extensively documented (Booz-Allen Applied Research, Inc., 1973). In general:

- Aliphatic or cyclic aliphatics are usually more susceptible to biological degradation than aromatics.

- Unsaturated aliphatics, such as acrylics, vinyl, and carbonyl compounds are generally biodegradable.

- Molecular size is significant concerning the biodegradability of an organic compound. Polymeric and complex molecular substances have shown resistance to biological degradation, part of which is attributed to the inability of the necessary enzymes to approach and attack susceptible bonds within the molecular structure.

- Structural isomerisms in organic compounds affect the relative biodegradability of many compound classes. For example, primary and secondary alcohols are extremely degradable while tertiary alcohols are resistant.

- The addition or removal of a functional group affects the biological oxidation. A hydroxyl or amino substitution to a benzene ring renders the compound more degradable than the parent benzene, while a halogen substitution causes it to be less biodegradable.

- Many organic compounds are extremely biodegradable at low concentrations but are bio-static or bio-toxic at higher concentrations.

The presence of certain materials can adversely affect the biological treatment system; these substances may need to be removed, using other treatment processes previously discussed, before biological treatment can be undertaken. For example, oils are difficult for most microorganisms to metabolize due to their low water solubility. Inorganic and non-biodegradable organic suspended solids tend to build up in a treatment system, decreasing the proportion of active biological solids, and thus adversely affecting the treatment efficiency. Sulfides react with dissolved oxygen and reduce the available oxygen to the organisms. Heavy metals are toxic and must be removed or reduced to safe levels. Also, waste streams with potentially toxic organic compounds need to be separated and treated prior to discharge into the biological treatment system (Booz-Allen Applied Research, Inc., 1973). The biological treatment methods in typical use include: trickling filters, activated sludge, aerated lagoons, and waste stabilization ponds.

D.1.3.1 Trickling Filters. A trickling filter consists of a packed bed of stones or synthetic materials covered by a microbial film. As the wastewater passes over the filter medium and trickles downward, biodegradable materials are oxidized. The "filtered" liquid is collected and discharged at the bottom. Trickling filters are commonly used in industrial waste treatment as "roughing devices" designed to equalize and reduce organic loads to activated sludge or aerated lagoon processes. Trickling filters have been employed in the treatment of acetaldehyde, acetic acid, acetone, acrolein, alcohols, benzene, butadiene, chlorinated hydrocarbons, cyanides, epichlorohydrin, formaldehyde, formic acid, ketones, monethanolamines, phenolics, propylene dichloride, terpenes, ammonia, ammonium nitrate, nylon and nylon chemical intermediates, resins, and rocket fuels (Office of Solid Waste Management Programs, 1974a).

D.1.3.2 Activated Sludge. The activated sludge process consists of adding a biological population to wastewater sludge in the presence of dissolved oxygen produced by aeration. The organisms digest the organic components of the sludge and then settle out by gravity to be used again. The activated sludge process is most adaptable for treating biodegradable organic wastes with influent biological oxygen demand (BOD) less than 3000 mg/l (Ottinger, et al., 1973). The process has been used in the treatment of refinery, petrochemical and biodegradable organic wastewaters (Office of Solid Waste Management Programs, 1974a).

D.1.3.3 Aerated Lagoon. Aerated lagoons consist of surface impoundments in which organic waste stabilization is accomplished through continuous contact of the wastewater with a biological population. Oxygenation of the lagoon is generally provided by mechanical aeration.

There are two general types of aerated lagoons: aerobic lagoons and facultative lagoons. In the aerobic lagoon, all biologic solids are kept in suspension to insure aerobic conditions. In the facultative lagoon, sludge settling is allowed to occur and, as a result, aerobic biochemical oxidations takes place near the surface and anaerobic decomposition takes place in the bottom of the basin. High levels of treatment are not generally achieved in aerated lagoons because of the BOD and chemical oxygen demand (COD) associated with the effluent suspended solids and the relatively small number of active biological solids in contact with the wastewater. Aerated lagoons are particularly sensitive to transient organic loadings, toxic substances, and temperature changes (Booz-Allen Applied Research, Inc., 1973; Ottinger et al., 1973).

D.1.3.4 Waste Stabilization Ponds. In waste stabilization ponds, wastewaters are stored in large, shallow surface impoundments under conditions that favor the growth of algae and the natural process of bacterial and algal symbiosis. Stabilization occurs when organics are converted to inorganics through the metabolic activity of the algae, aided by surface aeration (Office of Solid Waste Management Programs, 1974a).

The BOD removal in stabilization ponds is comparable to that in other biological treatment processes, but the COD reduction capacity is often higher. However, highly colored substances reduce sunlight penetration and cause reduced photosynthesis, often affecting COD removal capacities (Booz-Allen Applied Research, Inc., 1973).

D.1.4 Thermal Treatment. Thermal treatments employ heat to destroy hazardous wastes, to render the waste less hazardous, and to recovery energy and materials from the waste. To the extent that thermal treatment produces a hazardous ash or residual that requires disposal, thermal treatment constitutes a treatment method rather than a disposal method. Thermal treatments in typical use include: open burning, open pit burning, incineration, and high temperature processing.

D.1.4.1 Open Burning. Open burning is defined under the Subtitle C regulations as the combustion of any material without control of combustion air to maintain adequate temperature for efficient combustion, containment of the combustion-reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion, or emission of the combustion products through a stack or vent adequate for both visual monitoring and point source sampling. Open burning of hazardous wastes results in the uncontrolled release of hazardous gases and particulate matter. Open burning, is being phased out due to the implementation of the Clean Air Act. It should be noted that open burning is still used to dispose of those explosive wastes for which there is no alternative treatment or disposal method available, e.g., white phosphorus shells, certain surplus rocket motors, and items too deteriorated for safe disassembly (Shapira et al., 1978).

D.1.4.2 Open Pit Burning. Open pit burning is a form of open burning which consists of a 10 foot to 30 foot deep pit with a row of air nozzles directed downward at an angle of 25° to 35° across the back that create a rolling action of high velocity air over the burning zone. Wastes are introduced by means of loading ramp opposite the nozzles. A screen across the top of the incinerator prevents escape of large airborne particles and controls insects and rodents. Open pit burning has been used extensively to burn industrial trash, tars, and sludges (Powers, 1976).

D.1.4.3 Incineration. Incineration is defined under the Section 3004 regulations as an engineered process using controlled flame combustion to thermally degrade materials (e.g., hazardous wastes). Devices normally used for waste incineration include rotary kilns, fluidized bed incinerators, multiple hearth incinerators, and liquid injection incinerators.

Rotary Kilns. Rotary kilns consist of a slowly rotating combustion chamber that is slightly inclined to the horizontal; the kiln rotates around its longitudinal axis during combustion and continually mixes the waste materials and exposes fresh surfaces for combustion. Rotary kilns can be used for the incineration of combustible solids, gases, liquids, tars, and sludges as well as for waste chemical warfare agents and munitions. Combustion temperatures vary according to the characteristics of the waste material being incinerated, but normally vary from 810 C to 1650 C; residence times typically vary from several seconds to hours, depending upon the waste (Reynolds, Smith and Hills, 1977; Scurlock et al., 1975).

Fluidized Bed Incinerator. Fluidized bed incinerators essentially consist of a vessel containing a bed of inert granular particles, such as sand, through which pressurized air is forced upward. The air causes the bed to behave like a dense, fluid-like mass. Wastes are injected into the fluidized material and combusted. The constant bed agitation creates an effective mixing of the wastes with the air and also allows larger waste particles to remain suspended until combustion is completed.

Fluidized bed incinerators can be used for combustible solid, liquid, and gaseous waste materials. Fluidized bed incinerators have been used for waste treatment and disposal in the petroleum and paper industries and for incineration of sewage sludge. Combustion temperatures typically range from 760 C to 870 C; the maximum temperature that can be used for fluidized bed incinerators with sand beds is 1090 C. Residence times typically vary from seconds for gases to longer times for solids (Reynolds, Smith and Hills, 1977; Scurlock et al, 1975; Jacobs Engineering Company, 1976).

Multiple Hearth Incinerators. The multiple hearth incinerator consists of a refractory-lined, circular, steel shell with refractory hearths located one above the other. Wastes enter at the top and drop from one hearth to the next with the residual ash falling to the floor of the incinerator. Multiple hearth incinerators were originally developed for incineration of sewage sludge, but are now also used for tars, solids, gases, and other combustible wastes. When sludge is incinerated, the multiple hearth has three operating zones: drying, incineration, and ash cooling. Temperatures range from 315 C to 540 C in the drying zone and from 760 C to 980 C in the incineration zone. Residence times typically range up to several hours for solids (Reynolds, Smith and Hills, 1977; Scurlock et al., 1975).

Liquid Injection Incinerators. Liquid injection incinerators consist of either vertical or horizontal units into which an atomized liquid waste is fed. The waste is atomized mechanically or with steam or air. Liquid injection incinerators can be used for almost all combustible liquid wastes (including slurries) which have a viscosity of less than 1000 Saybolt Universal Seconds. Operating units are incinerating such wastes as chlorinated hydrocarbons, sulfur containing compounds, DDT, solvent fumes, and mustard gas. Combustion temperatures range from 650 C to 1650 C with most units operating around 870 C. Residence times typically range from 0.1 to one second (Reynolds, Smith and Hills, 1977; Scurlock et al., 1975).

D.1.4.4. High Temperature Processing. High temperature processing involves the use of heat and/or pressure to decompose, oxidize, volatilize, distill, or affect other changes in wastes. Types of high temperature processing include calcination, wet oxidation, and pyrolysis.

Calcination. Calcination is a thermal decomposition process, generally operated at atmospheric pressure, that can be applied to aqueous slurries, sludges, and tars to drive off volatiles and to produce a dry powder or calcined solid. Typical calciners include the open hearth, rotary kiln, and fluidized bed. Calcination is particularly useful when a one-step process is required to deal with a complex waste, as it destroys organic components and leaves inorganic components in a form generally more acceptable for recovery or landfilling. Calcination may be used to decompose salts or other compounds to form an oxide that is generally more stable or reusable than the original waste. Typical examples are the calcination of carbonates, hydroxides, sulfites, sulfides, sulfates, and nitrates to corresponding oxides with evolution of carbon dioxide, water, sulfur dioxide, and nitrogen oxides, respectively (Versar, 1977).

Wet Oxidation. Wet oxidation is a physical/chemical process capable of breaking down organic materials through flameless oxidation. Solids are first solubilized and complex hydrocarbons are broken down via hydrolysis reactions. The relatively simple hydrocarbons are then oxidized to alcohols, aldehydes, acids, and ultimately to carbon dioxide and wastes. The process is carried out at temperatures in the range 150 C to 340 C and at high pressure on the order of 316,000 to 1,750,000 kilograms per square meter. Residence times typically range from 10 to 30 minutes. The process has been applied to stabilization of sewage sludge. However, it appears to have a relatively low destruction efficiency for organics and also produces organic breakdown products (Scurlock et al., 1975).

Pyrolysis. Pyrolysis is a process whereby organic material is thermally decomposed into its solid, liquid, and gaseous constituents through destructive distillation in the absence of oxygen. Typical gaseous products include steam, carbon dioxide, carbon monoxide, hydrogen, and methane; the liquid condensate may contain methane, ethane, other alcohols, acids, and tars; the solid residue or char contains carbon and ash. Pyrolysis processes for energy recovery from solid wastes are currently being demonstrated, but are not yet available on a commercial scale (Energy Research and Development Administration, 1977; Levy, 1975).

Inorganic Waste Treatment. Although not flammable, inorganic hazardous wastes in some cases can be decomposed, smelted, roasted, volatilized, and/or distilled in fashion similar to recovery of metals from ores. For example, mercury can be driven from wastes by heating in furnaces and retorts, condensed in chilled heat exchangers, and recovered. Smelting operations are also widely used for metal recovery from hazardous metallic wastes (Versar, Inc., 1975).

D.2 Methods for Ultimate Disposal

Ultimate disposal involves the discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous waste into or on any land or water so that such waste or any constitutent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters. Methods typically used for ultimate disposal of hazardous wastes include: open dumping, landfilling, landfarming, surface impoundment (lagooning), incineration, deep-well injection, discharge to municipal sewer systems, surface discharge to streams and river[illegible] ocean dumping, road application, and detonation. In addition, engineered storage is used in some instances when there is no known safe method of treatment or disposal of a hazardous waste.

Several of the above disposal methods are regulated under other Federal acts and are not regulated under Subtitle C of RCRA. Ocean dumping is regulated under the Marine Protection, Research and Sanctuaries Act of 1972. Surface discharges to navigable waters and discharges to municipal sewer systems are both regulated under the Federal Water Pollution Control Act; furthermore, wastes put directly into a domestic sewer line at the point of generation and wastes in regulated point source industrial discharges cannot be considered a hazardous waste because RCRA specifically excludes from the definition of hazardous wastes any "solid or dissolved materials in domestic sewage...or industrial discharges which are point sources subject to permits [National Pollutant Discharges Elimination System (NPDES)] under section 402 of the Federal Water Pollution Control Act." Deep-well injection is regulated under the Safe Drinking Water Act.

D.2.1. Open Dumping. Open dumps are uncovered land disposal sites where wastes are deposited with little or no regard for pollution control, containment, or aesthetics. Wastes in such dumps are susceptible to open burning (accidentally or intentionally) and leaching. In addition, they are exposed to the elements, vectors, and scavengers.

Open dumping has been a prevalent form of hazardous waste disposal in the past. While there is no national inventory of privately owned industrial land disposal sites, it is estimated that there were about 18,500 land disposal sites which accepted municipal wastes in 1974 and about 16,000 in 1976 (*Waste Age*, 1977); most of these sites also received some industrial wastes and most were open dumps or poorly sited and operated landfills (Office of Solid Waste Management Programs, 1977). Industries in which open dumping of potentially hazardous wastes has been a prevalent practice include the metal smelting and refining industry, the inorganic chemicals industry, the leather tanning industry, the electroplating and metal finishing industries, and the special machinery manufacturing industries (Calspan Corporation, 1977; Versar, Inc., 1975; SCS Engineers, Inc., 1976; Battelle Columbus Laboratories, 1976; Wapora, Inc., 1977).

Open dumping of solid wastes is prohibited under Subtitle D of RCRA and such open dumping is to be eliminated within five years from the date of the publication of the inventory of open dumps required under Subtitle D.

D.2.2 Landfills. The use of landfills is one of the major practices currently used for the disposal of hazardous wastes (Industry Studies, 1975-1978). Data are not available to estimate the total quantity of hazardous wastes disposed in landfills. However, it has been estimated that annually during the period from 1973 to 1975, nearly a third of the hazardous wastes from 14 manufacturing industries were disposed of in open dumps and landfills and that less than eight percent of this disposal was in secure landfills (Office of Solid Waste, unpublished data). Landfills may be classified as general purpose landfills, sanitary landfills, and secure landfills.

D.2.2.1 General Purpose Landfills. General purpose landfills are land disposal sites located without regard to possible effects on water resources, but which employ intermittent or daily cover to minimize scavenger, aesthetic, vector, and air pollution problems. General purpose landfills do not have provisions for special containment, monitoring, or leachate treatment. According to the Industry

Studies, the vast majority of the industrial hazardous wastes that are disposed in landfills are disposed in general purpose landfills.

D.2.2.2 Sanitary Landfills. Sanitary landfills are disposal sites employing an engineered method to dispose solid wastes on land in a manner that reduces environmental hazards by spreading the wastes in thin layers, compacting the waste to the smallest practical volume, and compacting with cover material at the end of each operating day. Sanitary landfills do not usually have provisions for special containment, monitoring, or leachate treatment. There is no inventory of industrial sanitary landfills; however, a survey of municipal landfills (Waste Age, 1977) indicated that in 1976 there were about 5,800 landfills recognized as sanitary landfills in compliance with state regulations; most of these receive some industrial wastes. According to the Industry Studies (1975-1978), a small portion of the industrial hazardous wastes that are disposed in landfills are disposed in sanitary landfills.

D.2.2.3 Secure Landfills. Secure landfills are land disposal sites that allow no hydraulic connections with natural waters, segregate wastes, have restricted access, and are continuously monitored. According to the Industry Studies (1975-1978), a negligible portion of the industrial hazardous wastes that are disposed in landfills is disposed in secure landfills. The total number of secure landfills is unknown. However, in 1976 there were about 100 municipal landfills with impermeable linings and about 200 with leachate collection systems (Waste Age, 1977). In addition, it is estimated that there were 20 secure commercial landfills in 1977 (Straus, 1977).

D.2.3 Landfarming. Landfarming involves the application of wastes onto land and incorporation into the surface soil, for the purpose of attenuation. Landfarming is also commonly called land application, land cultivation, land irrigation, land spreading, soilfarming, and soil incorporation.

Wastes amenable to landfarming are those that contain constituents that can be decomposed by soil microorganisms. Currently, wastewater treatment sludges account for nearly all of the wastes being landfarmed; approximately 25 percent of the five million metric tons (dry weight) of municipal wastewater treatment sludge generated annually is landfarmed, primarily on agricultural lands (Office of Solid Waste, 1978). Data are not available as to the portion of these sludges that are potentially hazardous. Limited data are available as to the extent of landfarming of hazardous manufacturing wastes. These data indicate that only a few manufacturing industries have well established landfarming practices. For example, over eight percent of the potentially hazardous wastes from the petroleum refining industry have been disposed by landfarming in recent years (Jacobs Engineering Company, 1976); small quantities of potentially hazardous sludges from the leather tanning and finishing industry and the organic chemicals industry are also landfarmed (SCS Engineers, Inc., 1976; TRW, Inc., 1976). Industries which do not presently practice landspreading of potentially hazardous wastes to any significant extent include the inorganic chemicals, metal smelting and finishing, and electroplating and metal finishing industries (Office of Solid Waste Management Programs, 1977). It is estimated that annually during the period from 1973 to 1975, less than 0.5 percent of the hazardous wastes from 14 manufacturing industries were disposed of by landfarming (Office of Solid Waste, unpublished report).

A typical landfarming practice by the petroleum refining industry is described as follows (Jacobs Engineering Company, 1976):

> "Waste material is pumped into a vacuum truck and conveyed to a disposal site. The oily waste is pumped from the truck through a hand-held discharge hose, which the truck driver guides in spreading the discharged material as evenly as possible on the assigned land area. The actual depth of application is determined by experience, and varies with the oil composition of the discharge, the soil's moisture and nutrient content, climatologic conditions, and amount of available land. The application rates for oily sludge vary from one to two inches in thickness in the Northwestern U.S. to as much as 3" and 4" in the warmer, subtropical climates of the Southwestern United States. The rate of degradation and disappearance of oil requires between one and six months, depending upon the thickness of the sludge deposit, percent by weight oil content, amount of fertilizer used, and frequency of tilling. Successive loads are handled in the same manner, with each load applied in approximately the same thickness to an immediately adjacent plot. The process is continued until a large area is covered by the oily sludge or waste material. After much of the water has evaporated, a tractor-drawn plow or rototiller is used to break up the oily crust and mix it with a surface layer of soil. The frequency of rototilling, plowing and aeration varies from one location to another. A common practice is to plow the material into the ground to a depth of about six to eight inches and to periodically aerate and blend the oily sludge with the soil. In the Southern United States, a rototiller many go as deep as eight to fourteen inches to entrain air in the subsurface layers of the soil."

D.2.4 Surface Impoundments. A surface impoundment is any natural depression or excavated and/or diked area built into or upon the land, which is fixed, uncovered, and lined with soil or a synthetic material. Examples include lagoons, holding ponds, and aeration ponds.

Surface impoundments are currently used for the storage, treatment, and/or disposal of liquid wastes and semi-solid wastes such as slurries. Treatment practices carried out in surface impoundments include biochemical stabilization, evaporation, solids separation, neutralization, and precipitation as well as other physical, chemical, and biological treatments. In some instances, sediments and sludges which build up in the impoundments during storage and treatment practices are dredged and disposed elsewhere, primarily in landfills; in other instances, the impoundments are allowed to fill, and the accumulated sediments and sludges are left permanently in the impoundment.

It is estimated that there are over 100,000 surface impoundments for industrial wastes in the U.S. (Office of Solid Waste, 1978). About 1,700 billions gallon of industrial wastes, (not all hazardous) are pumped annually to oxidation ponds or lagoons for wastewater treatment, and unknown quantities of industrial wastes are stored, treated, or disposed in other types of surface impoundments. Over 100 billion gallons of this industrial wastewater are estimated to enter the groundwater system annually (Office of Solid Waste Management Programs, 1977). Available data are not sufficient to estimate the total amount of hazardous wastes placed in surface impoundments, the portion of these wastes ultimately disposed in such impoundments, nor the portion which leaks to the groundwater. It has been estimated that annually during the period from 1973 to 1975, over 48 percent of the hazardous wastes from 14 manufacturing industries were ultimately disposed in surface impoundments and that over 99.9 percent of the disposal was in unlined surface impoundments (Office of Solid Waste, unpublished report).

D.2.5 Incineration. To the extent that incineration does not generate a hazardous residual requiring disposal, incineration constitutes a method of disposal. Incineration methods are discussed in Section D.1. Data are not available to estimate the total quantity of hazardous wastes incinerated annually, nor the portion of this incineration that constitutes ultimate disposal. However, it has been estimated that annually during the period from 1973 to 1975, over 15 percent of the hazardous wastes from 14 manufacturing industries were incinerated and that over 63 percent of this incineration was uncontrolled (Office of Solid Waste, unpublished report).

D.2.6 Road Application. Road application involves the placing of waste materials, primarily waste oils and sludges, on roads for the purpose of road oiling and dust control. It is estimated that over 1.1 billion gallons of waste oil are generated annually in the U.S. and that over 200 million gallons of the oil are used in road oil and asphalt (U.S. Environmental Protection Agency, 1974). Data are not available to estimate the portion of this waste oil that is hazardous. However, for the period 1973 to 1975, it has been estimated that less than 0.1 percent of the hazardous wastes from 14 manufacturing industries was disposed annually by road application (Office of Solid Waste, unpublished report). In 1975, over 6 percent of potentially hazardous wastes from the petroleum refining industry were disposed through road application (Swain et al., 1977).

D.2.7 Detonation. Detonation is used for the disposal of some conventional munitions and explosives. Disposal is typically carried out by placing the waste munitions and explosives in wide, shallow pits and detonating them or by mounding earth over the waste munitions and explosives and detonating them (Shapira et al., 1978). Data are not available to estimate the total quantity of waste conventional munitions and explosives annually disposed by detonation; however, the quantity is believed to be small when compared to the quantity of explosives detonated by the commercial blasting industry (Shapira et al., 1978).

D.2.8 Engineered Storage. Engineered storage is used when there is no safe method of disposal of a particular hazardous waste. Under these circumstances the wastes are containerized and buried or otherwise stored until technologies are developed for treating and disposing of them. Wastes that have been subject to engineered storage in recent years include mercury and phosphorus contaminated wastes from the inorganic chemicals industry; mercury containing wastes from the primary battery industry; salts from the destruction of chemical warfare agents; and pesticides such as arsenic trioxide, cacodylic acid, and kepone (Versar, 1975; Versar, 1975a; Ottinger et al., 1973; Powers, 1976). Data are not available to estimate the quantity of wastes subject to engineered storage.

D.3 Treatment and Disposal Practices by Selected Manufacturing Industries

Thirteen manufacturing industries which were the subject of the Industry Studies (1975-1978) on hazardous waste practices are used as the basis for characterizing existing hazardous waste treatment and disposal practices. See Appendix C for a discussion of the scope and limitations of the Industry Studies.

D.3.1 Textiles Industry. Table D-1 presents typical treatment and disposal practices for the hazardous wastes generated by the textiles industry (SIC 22), based upon information reported by Versar, Inc. (1976). Potentially hazardous waste streams generated by the industry consist of wastewater treatment sludges, dye containers, chemical containers, solvent and still bottom wastes, and contaminated fibers.

On-site treatment generally consists of wastewater treatment, limited washing of dye and chemical containers prior to disposal, and segregation of some solvent and still bottom wastes for solvent recovery operations. Some dye and chemical containers are also returned to suppliers for reuse or recycling. On-site reclamation of potentially hazardous wastes is not practiced. Off-site reclamation

TABLE D-1

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE TEXTILES INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Wastewater treatment sludges	not reported	not reported	not reclaimed	not reclaimed	indefinite storage in ponds and lagoons; landfill; discharge of wastewater to municipal treatment systems; landspreading	landfill; landspreading
Dye and chemical containers	limited washing of containers;	not reported	return of containers to suppliers	recycling of containers	not disposed on-site	landfill; dump
Solvent and still bottom wastes	segregation for recovery	drummed; mixed with other solid wastes	not reclaimed	limited solvent recovery	not disposed on-site	landfill; incineration
Contaminated Fibers	not treated	limited segregation from other solid wastes	not reclaimed	not reclaimed	not disposed on-site	landfill

*Versar, Inc., 1976.

includes recycling or reuse of dye or chemical containers and very limited solvent recovery.

Based upon the study by Versar, Inc., in 1974 approximately 49 percent of the potentially hazardous wastes were disposed on-site, primarily through lagooning and ponding; about 51 percent of the wastes were disposed off-site, primarily through landfilling. A very limited percent of the potentially hazardous wastes (<<0.5 percent) were reclaimed off-site.

D.3.2 Inorganic Chemicals Industry. Table D-2 presents typical treatment and disposal practices for the hazardous wastes generated by the inorganic chemicals industry (SIC 281), based upon information reported bv Versar, Inc. (1975). Potentially hazardous wastes are generated by the following subcategories of the industry: alkalies and chlorine production, inorganic pigment production, and industrial inorganic chemicals not elsewhere classified.

On-site treatment of potentially hazardous wastes generally is limited to segregation, neutralization and dewatering of various wastes, and wastewater treatment. Some chlorinated hydrocarbons are incinerated and produce residues requiring disposal.

Phosphorus, mercury, and some other metals are recovered on-site from wastes identified as potentially hazardous by Versar, Inc. Some of the chlorinated hydrocarbon wastes are recycled through use in organic chemicals manufacture. Except for mercury recovery, off-site reclamation of potentially hazardous wastes is not generally practiced.

TABLE D-2

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE INORGANIC CHEMICALS INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Mercury contaminated wastes	treatment for recovery	drummed	retort for mercury recovery	mercury recovery	landfill; ponding; storage in drums	landfill
Asbestos and lead contaminated wastes	segregation and dewatering	not reported	not reclaimed	not reclaimed	landfill; ponding	landfill
Chlorinated hydrocarbons	segregation; incineration	drummed	used in organic chemicals manufacture	not reclaimed	incineration; landfill; discharge to municipal sewer system	landfill
Metallic sodium and calcium sludges	not generally treated	not reported	not reclaimed	not reclaimed	not disposed on-site	barge to sea
Titanium dioxide pigment production	neutralization	not reported	not reclaimed	not reclaimed	ponding; deep-well injection	landfill; barge to sea
Chrome pigments production	neutralization and precipitation	not reported	metal recovery	not reclaimed	ponding; landfill	landfill
Inorganic acids manufacture	not generally treated	not reported	not reclaimed	not reclaimed	ponding	landfill; roadfill
Fluoride manufacture	not generally treated	not reported	not reclaimed	not reclaimed	ponding; dump; deep-well injection	landfill
Phosphorus containing wastes	settling	not disposed off-site	phosphorus recovery	not reclaimed	landfill; drum storage; dumping	not disposed off-site

*Versar, Inc., 1975.

Based upon the Versar, Inc. study (1975), in 1973 approximately 84 to 89 percent of the total potentially hazardous wastes were disposed on-site. Typical on-site disposal methods included landfills, storage ponds, deep-well injection, dumps, incineration, and discharge to municipal sewer systems. In addition, some mercury contaminated wastes and some phosphorus contaminated wastes were being stored indefinitely on-site in drums pending further developments in treatment/disposal methods. Approximately 10 to 15 percent of the hazardous wastes were disposed off-site, primarily by landfill or ocean dumping. Approximately 1 to 2 percent were reclaimed. The distribution of the total wastes treated/disposed by various methods in 1973 was as follows:

Treatment/Disposal	Percent
Ponds	20-30
Landfill	
General	32
Approved	5
Secure	5
Deep-well injection	14
High temperature processing*	1-2
Incineration	<1
Municipal sewers	<1
Dump	Not available

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*Smelting, roasting, volatilization, distillation.

Storage drum	Not available
Ocean dumping	Not available

D.3.3 Pharmaceutical Industry. Table D-3 presents typical treatment and disposal practices for the hazardous waste generated by the pharmaceutical industry (SIC 2831, 2833, and 2834), based upon information reported by Arthur D. Little, Inc. (1976b). Potentially hazardous waste streams generated by the industry include waste solvents, organic chemical residues, contaminated high inert content wastes, heavy metal wastes, and active ingredients.

On-site treatment generally consists of incineration of waste solvents (primarily non-halogenated waste solvents), organic chemical residues, contaminated high inert content materials containing flammable solvents, and some rejected or returned active ingredient materials and formulations. Incineration generates small quantities of ash, primarily from contaminated high inert content wastes and active ingredients, which is land disposed. Small quantities of organic chemical residues and active ingredients are sent to biological wastewater treatment.

Most process solvents are recovered and reused on-site; as a result, only those waste solvents which result from the solvent recovery operations are considered by the Arthur D. Little study (1976b) to be a hazardous waste. Except for the solvent recovery, there is little or no on-site reclamation of potentially hazardous waste materials. Some heavy metals, primarily zinc and chromium, are

TABLE D-3

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE PHARMACEUTICAL INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Waste solvents	Incineration+	not reported	+	some energy recovery and production of low-grade fuel	incineration, primarily of non-halogenated solvents	incineration
Organic chemical residues	incineration; small amounts sent to biological wastewater treatment	not reported	not recovered	not recovered	incineration; landfill; small amounts sent to biological wastewater treatment	incineration; landfills
Contaminated high inert content materials	incineration of solvent contaminated materials	not reported	not recovered	not recovered	incineration of solvent contaminated materials	incineration; landfill
Heavy metals	not treated	drummed	not recovered	recovery of some zinc and chromium wastes	not disposed on-site	landfill
Active ingredients	crushed, slurried with water, and sent to biological wastewater treatment; incineration	not reported	not recovered	not recovered	incineration; biological wastewater treatment	incineration; landfill

*Arthur D. Little, Inc., 1976b.

+Process solvents are extensively recovered; waste solvents result from the solvent recovery operations.

recovered off-site; however, the heavy metal content in most wastes is too dilute for economic recovery. A small portion of the waste solvents sent off-site is used for energy recovery (i.e., incineration to produce steam) or for production of a low-grade fuel.

Based on the study by Arthur D. Little, Inc., in 1973 approximately 39 percent of the potentially hazardous wastes were disposed on-site, primarily through incineration, with land disposal of any residual ash. About 60 percent of the wastes were disposed off-site either by incineration or landfilling. About 1 percent of the potentially hazardous wastes was recovered off-site. The percentage of the potentially hazardous wastes treated/disposed on-site and off-site are as follows:

Treatment/Disposal	On-Site	Off-Site
Incineration	37	51
Landfill	--	9
Biological treatment	2	--
Recovery	--	1
Total	39	61

D.3.4 Paint and Allied Products Industry and Contract Solvent Reclaiming Operations. Table D-4 presents typical treatment and disposal practices for the hazardous wastes generated by the paint and allied products industry (SIC 285) and contract solvent reclaiming operation, based upon information reported by Wapora, Inc. (1975). Potentially hazardous wastes generated by the paint and

TABLE D-4

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE PAINT AND ALLIED PRODUCTS INDUSTRY AND CONTRACT SOLVENT RECLAIMING OPERATIONS*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Paint and Allied Products						
Raw materials packaging	not treated	drummed	not generally reclaimed	not reclaimed	not generally practiced	landfill
Wastewater treatment sludges	some sludge settling and dewatering	drummed	not generally reclaimed	not reclaimed	not generally practiced	landfill
Solids from air pollution control	not treated	drummed	limited recycling in in lower grade products	not reclaimed	not generally practiced	landfill
Discarded products and spills	not treated	drummed	some recycling in lower grade products	not reclaimed	not generally practiced	landfill
Waste wash solvents	treatment for reclamation	drummed	limited solvent recovery	solvent recovery	not generally practiced	landfill
Solvent Reclaiming						
Still bottoms and sludges	incineration	drummed	not reclaimed	not reclaimed	incineration	incineration; landfill

*Wapora, 1975.

allied products industry consist of raw materials, packaging, wastewater treatment sludges, solids from air pollution control equipment, discarded products and spills, and waste wash solvents; potentially hazardous wastes from contract solvent reclaiming consist of still bottoms or sludge.

D.3.4.1 Paint and Allied Products Industry. On-site treatment of potentially hazardous wastes from the paint and allied product industry is limited to dewatering of about 20 percent of wastewater treatment sludges prior to disposal and treatment of waste wash solvents for solvent recovery. On-site reclamation consists of some recycling of discarded finished products, spilled materials, and air pollution control solids in lower grade products and a limited amount of solvent recovery. Off-site reclamation consists of solvent recovery; about 35 percent of the waste organic solvent generated is reprocessed off-site.

Based upon the study by Wapora, Inc., in 1974 less than 5 percent of the potentially hazardous wastes from the paint and allied products industry were disposed on-site; over 90 percent were disposed off-site, primarily in unsecured landfills; about 5 percent were recycled or reclaimed.

D.3.4.2 Solvent Reclaiming Operations. Solvent recovery operations generate potentially hazardous still bottoms and sludges. In 1974, about 14 percent of the still bottoms and sludges were disposed off-site in landfills. Essentially all the remainder was incinerated, about half on-site and half off-site. Incineration generated about 1,000 metric tons of potentially hazardous ash which was disposed off-site in landfills. Less than 0.1 percent of the total potentially hazardous waste was reclaimed for use as asphalt extender or concrete block filler.

D.3.5 Organic Chemicals, Pesticides, and Explosives Industries. Table D-5 presents typical treatment and disposal practices for selected potentially hazardous wastes generated by the organic chemicals (SIC 286), pesticides (SIC 2879), and explosives industries (SIC 2892), based upon information reported by TRW, Inc. (1976).

On-site treatment of these potentially hazardous wastes consists primarily of diluting, with water, those wastes destined for deep-well injections, concentration of some waste water by evaporation (e.g., red water from TNT manufacture and waste water from aldrin manufacture), and incineration. Less than 30 percent of most of the waste streams are placed in steel drums before land disposal.

On-site reclamation practices consist of energy recovery from incineration and metal recovery from incinerator ash and catalyst residues. In addition, red water from TNT production is sold to kraft pulp mills for reuse.

Based upon the TRW, Inc. study (1976) for the organic chemicals industry, in 1973 about 87 percent of the total potentially hazardous wastes from the selected plants were disposed on-site, 5 percent were

TABLE D-5

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE ORGANIC CHEMICALS AND PESTICIDES INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-site Disposal†	Reclamation†	Disposal†
Heavy ends from perchloroethylene purification	dilution with water; some incineration with ash placed in drum	--	not reclaimed	deep-well injection
Heavy ends from nitrobenzene production	drummed (30%)	--	some energy recovery when incinerated	landfill in plastic-lined drums
Solid tails from chlorinated solvents recovery	not generally treated	drummed	not generally reclaimed	landfill (off-site)
Liquid heavy ends from epichlorohydrin production	not treated	--	not reclaimed	on-site storage in steel tanks
Semisolid wastes from production of toluene diisocynate	drummed (25%)	--	some energy recovery when incinerated	landfill
Liquid heavy ends from ethylene dichloride recovery	not treated	not reported	not reclaimed	incineration (off-site)
Liquid heavy ends from methanol recovery	not treated	--	not reclaimed	incineration
Liquid heavy ends from production of acrylonitrile	not treated	--	not reclaimed	incineration
Distillate bottoms from production of maleic anhydride	not treated	--	not reclaimed	landfill

TABLE D-5 (Continued)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-site Disposal†	Reclamation†	Disposal†
Sludge from purification of lead alkyls	dewatered and incineration	--	lead recovery	incineration
Waste water from aldrin manufacturing	evaporation	--	not reclaimed	evaporation in asphalt-lined basin with periodic incineration of resultant sludge
Aqueous brine from neutralization in atrazine production	pH adjustment and filtration	--	not reported	Deep-well injection
Spent activated carbon from trifluralin production	not treated	--	not reclaimed	on-site storage in rubber-lined drums
Sludge from parathion production	not treated	--	not reclaimed	incineration
Semisolid filter cake waste from malthion production	detoxification with sodium hydroride	--	not reclaimed	secure landfill
Military explosives production				
Waste explosives	not treated	--	not reclaimed	open burning
Explosive-contaminated inert wastes	not treated	--	not reclaimed	open burning for combustibles; flashing (thermal decomposition) for noncombustibles

TABLE D-5 (Concluded)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-site Disposal[†]	Reclamation[†]	Disposal[†]
Military explosives production (cont'd)				
Spent activated carbon	not treated	--	not reclaimed	open burning
Red water	concentration by evaporation	--	sale to kraft pulp mills	incineration of concentrate from evaporation; sale to kraft pulp mills
Commercial explosives production				
Waste explosives	not generally treated	--	not generally reclaimed	open burning

[*] TRW, Inc., 1976.

[†] Except as noted, reclamation and disposal occurs only on-site

disposed off-site, and 8 percent were recovered on-site.* Table D-6 presents data on the portion of the potentially hazardous wastes treated/disposed by various methods both on-site and off-site. For the organic chemicals industry as a whole, the percentage of off-site disposal is believed to be slightly higher than that of the selected plants; however, data are not available to estimate the percentage.

The organic chemical industries generates about 92 percent of the total potentially hazardous wastes from the organic chemicals, pesticides, and explosives industries. Sufficient data are not available to estimate the portion of wastes disposed on-site and off-site for the pesticides and explosives industries which generate 7 percent and 1 percent of the total potentially hazardous wastes, respectively.† In the pesticide industry, in 1973 approximately 40 percent of the hazardous waste streams studied by TRW, Inc. were disposed of via landfill (comprised of 28 percent on-site and 12 percent off-site), 16 percent via incineration, 13 percent via indefinite storage in drums or open piles, 8 percent via resource recovery, and 23 percent via other methods. These percentages are based strictly upon the number of waste streams sampled, not on the volume of waste generated. Data are not available to estimate the

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*Percentages are based upon dry weight since the TRW study indicated that percentages based upon wet weight are distorted by the dilution water used in deep-well injections. The wet weight percentages are about 96 percent disposed on-site, about 2.5 percent disposed off-site, and about 1.5 percent recovered on-site.

†The available data relate to the number of waste streams disposed on-site and off-site, not to the quantities disposed.

TABLE D-6

PERCENTAGE OF HAZARDOUS WASTES TREATED/DISPOSED ON-SITE AND OFF-SITE AT SELECTED ORGANIC CHEMICAL PLANTS IN 1973[*]

Treatment/disposal method	On-site[†]	Off-site[†]
Incineration	69.6	1.5
Uncontrolled	48.0	
Controlled	21.6	
Landfill	14.8	3.6
Deep-well injection	2.0	-
Biological treatment/lagoon	0.2	-
Landfarm	NA[‡]	NA
Recovery	8.3	-
Total	94.9	5.1

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[*] TRW, Inc., 1976.

[†] Percentage based on dry weight.

[‡] NA indicates not available.

volume of wastes disposed by each method. For the explosives industry, open burning was the predominant method of hazardous waste disposal in 1973; however, open burning is being phased out, to a large extent, under current air pollution regulations.

D.3.6 Petroleum Refining Industry. Table D-7 presents typical treatment and disposal practices for the petroleum refining industry (SIC 2911), based upon information reported by Jacobs Engineering Company (1976).

Many of the potentially hazardous waste streams result from treatment and recovery operations and are not themselves generally subject to further on-site treatment or reclamation. Several wastes, e.g., spent lime, waste bio sludge, and storm water silt, are dewatered prior to disposal. Spent hydrofluoric acid from the hydrofluoric acid alkylation process is neutralized with lime (usually spent lime from boiler feedwater treatment). Limited quantities of a few wastes, e.g., crude tank bottoms, API separator sludge, and slop oil emulsion solids, are incinerated. Leaded tank bottoms are weathered prior to disposal.

On-site reclamation of potentially hazardous wastes generally consists of a very limited amount of oil recovery from such wastes as crude tank bottoms, API separator sludge, dissolved air flotation float, and slop oil emulsion solids. Spent lime is used to neutralize hydrofluoric acid alkylation process wastes. Kerosene filter clays are sometimes stockpiled for reuse in on-site oil spill cleanup. Off-site reclamation generally consists of metal recovery.

TABLE D-7

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE PETROLEUM REFINING INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Crude tank bottoms	limited treatment for oil recovery; limited incineration	periodically (1 to 10 years) pumped into vacuum truck	limited oil recovery	not reclaimed	landfill; landspreading; lagoon	landfill
Leaded tank bottoms	weathered and degraded	periodically (1 to 10 years) pumped from tank	not reclaimed	not reclaimed	landfill; disking into soil	not generally disposed off-site
Non-leaded tank bottoms	not treated	trucked	not reclaimed	not reclaimed	landfill; landspreading; lagoon	landfill
API separator sludge	results from wastewater treatment; limited incineration	pumped into vacuum trucks	limited oil recovery	not reclaimed	landfill; landspreading; lagoon	landfill
Neutralized HF alkylation sludge	neutralized with spent lime	pumped into vacuum trucks	not reclaimed	not reclaimed	landfill	landfill
Kerosene filter clays	some stockpiling for spill clean-up (volatile light hydrocarbons evaporate and oil degrades)	trucked	not reclaimed; limited reuse for spill clean up	not reclaimed	landfill	landfill
Once-through cooling water sludge	not treated	trucked	not reclaimed	not reclaimed	landfill	landfill

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TABLE D-7 (Continued)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Dissolved air flotation float	limited centrification for oil recovery	pumped into vacuum trucks	limited oil recovery	not reclaimed	landfill; landspreading	landfill
Slop oil emulsion solids	limited incineration; some demulsification by chemical or physical means	trucked	limited oil recovery	not reclaimed	landfill; landspreading; lagoon	landfill
Spent lime	dewatered; used in spent acid neutralization	trucked	used in spent acid neutralization	not reclaimed	landfill	landfill
Cooling tower sludge	increased use of air cooling	pumped into vacuum trucks	not reclaimed	not reclaimed	landfill; process sewer system	landfill
Exchange bundle cooling sludge	not treated	shoveled out	not reclaimed	not reclaimed	landfill; process sewer system	landfill
Waste bio sludge	dewatered	trucked	not reclaimed	not reclaimed	landfill; landspreading; lagoon	landfill
Storm water silt	dewatered	excavation followed by trucking	not reclaimed	not reclaimed	landfill	landfill

TABLE D-7 (Concluded)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
FCC catalyst fines	collected by electrostatic precipitator	put in closed refuse containers	not reclaimed	limited aluminum recovery; potential source of vanadium; potential alumina cement additive	landfill	landfill
Coke fines	not treated	trucked	not reclaimed	not reclaimed	landfill	landfill
Lube oil filter clays	not generally treated	trucked	not generally reclaimed	not reclaimed	landfill	landfill
Spent catalyst	not generally treated	trucked	not generally reclaimed	metal recovery	landfill	landfill
Chemical precipitation sludge	not reported	not reported	not reported	not reported	not reported	not reported

*Jacobs Engineering Company, 1976.

Based upon the study by Jacobs Engineering Company (1976), in 1973 approximately 44 percent of the potentially hazardous wastes were disposed on-site, primarily through landfilling, landspreading, and lagooning. Approximately 56 percent of the wastes were disposed off-site, primarily by landfilling and lagooning. Table D-8 shows estimates of the percentage of wastes disposed/treated on-site and off-site by various methods in 1973 and projections for disposal/treatment in 1983.

D.3.7 Petroleum Rerefining Industry. Table D-9 presents typical treatment and disposal practices for the hazardous wastes generated by the petroleum rerefining industry (SIC 2992), based upon information reported by Swain et al. (1977). Potentially hazardous waste streams generated by the industry consist of acid and caustic sludges, spent clay, and process wastewater.

On-site treatment of acid and caustic sludges is not generally practiced; on-site treatment of process wastewaters typically consists of gravity separation to remove oils and solids, with some neutralization and coagulation employed.

Potentially hazardous wastes are generally not reclaimed, except for process wastewater which is recycled in many cases. In a few instances, caustic sludge is added to residual fuel oil for use in boilers or sold for use as an extender and plasticizer in asphalt manufacture.

Based on the study by Swain et al. (1977), in 1975 approximately 12 percent of the total acid and caustic sludges and spent clay were

TABLE D-8

ESTIMATE OF THE PERCENTAGE OF WASTES DISPOSED/TREATED ON-SITE AND OFF-SITE BY PETROLEUM REFINERY IN 1973 AND 1983*

Treatment/disposal method	1973		1983	
	On-site	Off-site	On-site	Off-site
Landfilling	16.8	34.3	24	20
Lagooning	18.3	21.4	12	7
Landspreading	8.4	0	34	0
Incineration	0.8	0	3	0
TOTAL	44.3	55.7	73	27

*Jacobs Engineering Company, 1976.

TABLE D-9

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE PETROLEUM REREFINING INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Acid and caustic sludges	not generally treated; mixed with cement dust or lime for neutralization in some instances	not reported	not generally reclaimed; added to residual fuel for boiler applications	not generally reclaimed; used in asphalt manufacture	landfill	landfill; applied on roads; added to residual fuel
Spent clay	not generally treated	not reported	not reclaimed	not reclaimed	landfill	landfill; applied on roads
Process wastewater	gravity separation to remove oils and solids; neutralization and coagulation	not reported	recycling	not reclaimed	sanitary sewer; drainage ditches; recycling in process	landfill

*Swain et al., 1977.

disposed on-site in landfills. About 76 percent was disposed off-site in landfills or applied to roads. The remaining 12 percent was recycled. Table D-10 presents a breakdown of disposal and recycling practices for each of these potentially hazardous waste streams.

D.3.8 Leather Tanning and Finishing Industry. Table D-11 presents typical treatment and disposal practices for the hazardous wastes generated by the leather tanning and finishing industry (SIC 3111), based upon information reported by SCS Engineers, Inc. (1976). Potentially hazardous wastes generated by the industry include wastewater treatment sludges, fleshings, trimmings and shavings, buffing dust, finishing residues, and sewer screenings.

On-site treatment of potentially hazardous wastes is limited to dewatering of wastewater treatment sludges, using gravity or mechanical means. On-site reclamation of potentially hazardous wastes is not generally practiced. Reclamation occurs off-site, primarily solvent recovery from finishing residues; some potentially hazardous trimming and shaving wastes are sold to producers of fertilizers, animal food supplements, glue, and foreign leather goods manufactures for use in their products.

Based upon the study by SCS Engineers, Inc. (1976), in 1974 approximately 10 percent of the potentially hazardous wastes were disposed on-site, the remainder were disposed off-site. Most of the disposal is by landfill, accounting for about 60 percent of the total waste quantity (about 10 percent of the landfills were sanitary land-

TABLE D-10

PERCENTAGE OF POTENTIALLY HAZARDOUS WASTE DISPOSED ON-SITE AND OFF-SITE OR RECYCLED IN 1975*

Hazardous waste stream	On-Site		Off-Site			Recycled	Total
	Landfill		Landfill		Roads		
	Treated	Untreated	Treated	Untreated	Untreated		
Sludge							
Acid	4.3	4.7	5.9	41.5	1.6	-	58.0
Caustic	-	-	-	-	2.5	11.8	14.3
Spent clay	0.8	2.1	1.7	21.0	2.0	-	27.6
Total	5.1	6.8	7.6	62.5	6.1	11.8	99.9

*Swain et al., 1977.

TABLE D-11

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE LEATHER TANNING AND FINISHING INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Wastewater treatment sludge	dewatering using gravity or mechanical means	drummed, pumped into tank trucks, or conveyed to dump truck	not reclaimed	not reclaimed	landfill; dump; lagoon	landfill; dump; lagoon
Fleshings	not treated	fiber or steel drums	not reclaimed	not reclaimed	landfill; dump	landfill; dump
Trimming and shavings	not treated	fiber or steel drums	not reclaimed	some reclamation for use in fertilizer, animal feed supplements, glue, and leather articles	landfill; dump	landfill; dump
Buffing dust	not treated; occasionally used in sludge dewatering	fiber or steel drums	not reclaimed	not reclaimed	landfill; dump	landfill; dump; agricultural landspreading
Finishing residues	not treated	drummed	not reclaimed	some solvent recovery	landfill; dump	landfill; dump
Sewer screenings	not treated	fiber or steel drums	not reclaimed	not reclaimed	landfill; dump	landfill; dump

*SCS Engineers, Inc., 1976.

fills; most of the remainder were converted dumps). About 25 percent of the total potentially hazardous wastes were placed in open dumps. Most of the remainder of the wastes was disposed in ponds or lagoons or discharged to muncipal sewer systems. Some buffing dust sludge was also used for agricultural land spreading.

D.3.9 Metal Smelting and Refining Industry. Table D-12 presents typical treatment and disposal practices for the potentially hazardous wastes generated by the metal smelting and refining industry (SIC 33), based upon information reported by Calspan Corporation (1977). Potentially hazardous waste streams generated by the industry consist of slags, sludges, slurries, dusts, scales, and pickle liquors.

On-site treatment generally is limited in the non-ferrous industries to placing sludges and slurries in unlined lagoons for solids settling. In the iron and steel industry, sludges are generally , dewatered before disposal. Some sludges, slurries, scales, and dusts are treated on-site for metal recovery. In the primary copper industry, zinc industry, lead industry, and aluminum industry, sludges, dusts, and other residues are typically stored on open ground for periods ranging from months to years before processing for metal recovery. In addition to on-site metal recovery, pickle liquors from the iron and steel industry are treated (primarily off-site) for acid regeneration.

TABLE D-12

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE METAL SMELTING AND REFINING INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal[†]	Reclamation[†]	Disposal[†]
Primary Copper				
Acid plant sludges	settling of suspended solids for recycle	-	recycled to reverbatory furnace	stored on land before recycle; overflow sent to mill tailings ponds
Dusts	treated for recycling	-	reclaimed for metal content	stored on land before recycling
Miscellaneous slurries	settled in unlined lagoons	-	some recycling for metal values	unlined lagoons; dredged material stored on land before recycling or open dumping
Primary Lead				
Sludge	settled in unlined lagoons; dredged material dried on ground	-	recycled for metal values	unlined settling pits and lagoons; dredged material stored on land before recycling or open dumping
Primary Zinc				
Sludge	settled in unlined lagoons	shipped to lead smelters	recovery of lead and other metals	unlined lagoons; dredged material stored on land before recycling or open dumping
Iron press residue	not treated	-	not generally reclaimed	open dump

TABLE D-12 (Continued)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal†	Reclamation†	Disposal†
Primary Aluminum				
Potliners and pot skimmings	treated for recovery	-	cryolite recovery (on-site and off-site)	stored on ground before reclamation (months to years)
Sludges	settled in unlined lagoons	-		unlined lagoons; dredged material open dumped
Dusts	not treated	-	not reclaimed	open dumping
Primary Antimony				
Slag	not treated	-	not reclaimed	open dumping
Anolyte sludge	not treated	-	not reclaimed	unlined tailings pond
Primary Mercury				
Condenser Wastewater	not treated	-	not reclaimed	unlined lagoon; spread on calcine dump
Primary Titanium				
Chlorination sludge	settled	trucked	not relcaimed	landfill or lagoon (both off-site)

TABLE D-12 (Continued)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal†	Reclamation†	Disposal†
Primary Tungsten				
Digestion Residue	treatement for metal recovery	-	metal recovery	stored on land before recycle (months to years)
Sludge	settled	-	not reclaimed	open dump
Primary Tin				
Slag	not treated	-	not reclaimed	open dump
Secondary Copper				
Slag	not treated	-	not reclaimed	open dump
Sludge	settled in unlined lagoons	-	not reclaimed	unlined lagoon
Secondary Lead				
Scrubber Sludge	not treated	-	not reclaimed	unlined lagoon
Secondary Aluminum				
Scrubber Sludge	not treated	-	not reclaimed	unlined lagoon
High Salt Slag	not treated	-	not reclaimed	open dump (50% on-site, 50% off-site)

TABLE D-12 (Continued)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal†	Reclamation†	Disposal†
Iron and Steel				
Ammonia liquor	Biological treatment	-	not reclaimed	Biological treatment
Lime sludge	dewatered	-	not reclaimed	open dump
Decanter tank tar	not treated	-	not reclaimed	open dump
Electric furnace dust	not treated	-	not reclaimed	open dump
Electric furnace sludge	dewatered	-	not reclaimed	open dump
Mill sludges	dewatered	-	some recycling for iron recovery (5%) and for tin recovery	open dump
Mill scales	80% treated for iron recovery	-	iron recovery	iron recovery; open dumping of scale from cold rolling mills
Pickle liquor	some treatment for acid regeneration	-	some acid regeneration (on-site and off-site)	neutralized in unlined lagoons off-site

TABLE D-12 (Concluded)

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal†	Reclamation†	Disposal†
Ferro alloys				
Sludge	settled	–	not reclaimed	dredged material to open dump
Dusts	wetted	–	not reclaimed	open dump
Skull plant tailings	not treated	–	not reclaimed	open dump

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*Calspan Corporation, 1977

†Essentially all reclamation and disposal occurs on-site, except as noted.

Based upon the study by Calspan Corporation, in 1974 approximately 98 percent of the potentially hazardous wastes were disposed/recovered on-site. The predominant practices for on-site disposal were open dumping and lagooning (unlined). Approximately 2 percent of the potentially hazardous wastes were disposed off-site, primarily in open dumps. On the order of 0.1 percent was reclaimed off-site.

D.3.10 Electroplating and Metal Finishing Industries. Table D-13 presents typical treatment and disposal practices for the potentially hazardous wastes generated by the electroplating and metal finishing industries (SIC 3471), based upon information reported by Battelle Columbus Laboratories (1976). Potentially hazardous wastes streams generated by the industry consist of water pollution control sludges, process wastes, degreaser sludges, and salt precipitates from electroless nickel wastes.

On-site treatment generally consists of concentration of water pollution control sludges to a 1 to 5 percent solids content through settling in lagoons, holding tanks, or clarifiers. Process wastes are not treated and are combined with non-hazardous plant wastes for disposal. Degreaser sludges are sent to the water pollution control facility or combined with the process waste stream. Salt precipitates from electroless nickle wastes are dewatered and combined with the water pollution control sludges. The potentially hazardous wastes are not reclaimed on-site or off-site.

Sufficient data are not available to estimate the portion of the total wastes treated/disposed on-site and off-site. The available

TABLE D-13

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE ELECTROPLATING AND METAL FINISHING INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal†	
			On-site	Off-Site	On-Site	Off-Site
Water pollution control sludges	concentrated to 1-5 percent solids by settling in lagoons, holding tanks, or clarifiers	not reported	not reclaimed	not reclaimed	lagoon; surface burial	landfill; open dump
Process wastes	not treated	combined with non-hazardous solid-wastes	not reclaimed	not reclaimed	surface burial	landfill; open dump
Degreaser sludges	sent to water pollution control facility or combined with process waste stream	‡	degreaser sludges result from solvent recovery operations	solvent recovery from waste solvents	‡	‡
Salt precipitates	dewatering	combined with water pollution control sludges	salt precipitates result from regeneration of electroless nickel baths	not reclaimed	lagoon; surface burial	landfill; open dump

* Battelle Columbus Laboratories, 1976.

† Considerable amounts of wastes are discharged into municipal sewer systems without treatment, but have not been identified.

‡ Same as that for water pollution control sludges or process wastes, as applicable.

data relate only to the number of firms treating/disposing on-site and off-site, not to the quantities treated/disposed. Based upon the study by Battelle Columbus Laboratories (1976), in 1975 about 64 percent of the firms studied disposed of wastes on-site, primarily by discharge to municipal sewer systems (45 percent of the firms) or by landfill (19 percent of the firms). Approximately 36 percent of the firms studied disposed of wastes off-site, primarily by landfill or open dumping.

D.3.11 Special Machinery Manufacturing Industries. Table D-14 illustrates typical treatment and disposal practices for the hazardous waste generated by the special machinery manufacturing industries (SIC 355 and 357), based upon information reported by Wapora, Inc. (1977). Potentially hazardous waste streams generated by the industry consist of those from heat treating, electroplating, machining, and coating operations.

On-site treatment of machining wastes generally consists of some filtering of oils for reclamation and reuse and separation of large pieces of metal wastes for off-site scrap salvage. Electroplating wastes are treated primarily for metal recovery to destroy cyanides and to neutralize acid and alkaline wastes. Smaller plants tend not to treat electroplating wastes prior to disposal. Heat treating wastes are treated primarily to destroy cyanides. Painting wastes are not generally treated prior to disposal.

TABLE D-14

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE SPECIAL MACHINERY INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Machining wastes	filtering of oils	drummed	reuse of coolants and cutting oils; lubricating and hydraulic oils burned in plant boiler; some solvent recovery	some solvent recovery; scrap metals recovered; some reclamation of cutting oils and quenching oils	some sewering of sludges; dumped; some incineration of waste oils	landfill
Electroplating	liquid waste equalization; cyanide destruction; no treatment by many small plants	smaller plants drum untreated wastes	metal recovery	not generally reclaimed	discharge to sanitary sewer	landfill
Heat treating wastes	cyanide destruction	not reported	metal recovery; some solvent recovery	some solvent recovery	discharge to sanitary sewer	landfill; incineration of some solid or semi-solid residues
Painting wastes	not generally treated	drummed	not generally reclaimed	not generally reclaimed	dumped	landfill; some incineration

*Wapora, Inc., 1977.

On-site reclamation typically consists of the reuse of coolants and cutting oils until they are too degraded for further recirculation; in a number of instances, oils are filtered to prolong their recirculation. Some spent lubricating and hydraulic oils are burned with fuel oil in plant boilers for energy recovery. Metals (e.g., copper, chrome, gold, silver, and rhodium) are typically reclaimed from heat treating and electroplating wastes for reuse in the process. A limited amount of solvent recovery is also practiced.

Off-site reclamation generally consists of metal recovery from scrap metal wastes. Some solvent recovery and reclamation of waste cutting and quenching oils for use as fuels or fuel additives also occurs.

Based on the study by Wapora, Inc., in 1975 approximately 10 percent of the potentially hazardous wastes were disposed on-site, principally by dumping on the ground, by incineration of waste oils, and by discharge to sanitary sewers. About 90 percent of the wastes were disposed off-site, primarily by landfilling, with some incineration also practiced.

D.3.12 Electronics Components Manufacturing Industry. Table D-15 presents typical treatment and disposal practices for the hazardous wastes generated by the electronics components manufacturing industry (SIC 367), based upon information reported by Wapora, Inc. (1977a). Potentially hazardous waste streams generated by the industry consist of halogenated and non-halogenated solvents, wastewater

TABLE D-15

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES FOR THE ELECTRONIC COMPONENTS INDUSTRY*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Halogenated solvents	treated for reclamation or incinerated	solvents containerized and labelled; still bottoms drummed	reclaimed by distillation; reused in process	reclaimed by repacking, distillation, fractionation	†	landfill
Non-halogenated solvents	incinerated	solvents containerized and labelled; still bottoms drummed	not generally reclaimed on-site	reclaimed by repacking, distillation, fractionation	sanitary sewer†	landfill
Wastewater	concentrated by lagooning, centrifugation or filtering	drummed, placed in dumpsters, or piped into tank trucks	not reclaimed	not reclaimed	lagoon	landfill
Oils	not generally treated	drummed or placed in dumpsters	petroleum distillate oils recycled; other oils not reclaimed	petroleum distillate oils reclaimed	†	landfill
Paint wastes	not generally treated	drummed or placed in dumpsters	not reclaimed	not reclaimed	†	landfill
Metal scraps	not generally treated	not reported	not reclaimed	sold to metal reclaimers	not reported	not reported
Concentrated cyanides	Oxidized and neutralized	--	--	--	no additional residue for land disposal	
Concentrated acids and alkalines	Oxidized and neutralized	--	--	--	no additional residue for land disposal	

*Wapora, Inc., 1977a.

†Small quantities dumped on-site.

treatment sludges, oils, paint wastes, metal scraps, concentrated cyanides, and concentrated acids and alkalies.

Segregation of potentially hazardous wastes for storage, treatment and/or disposal is a common practice in the industry. Except for oils and paint water, most potentially hazardous wastes are typically segregated. Oil and paint wastes are generally mixed with other solid wastes.

On-site treatment is common for halogenated solvent wastes, wastewater treatment sludges, and concentrated cyanides, acids, and alkalies. Treatment of halogenated solvent wastes involves incineration or reclamation by distillation. Incineration and reclamation produces still bottoms and residues requiring disposal. Solvents treated on-site are reused in operations which do not have stringent quality control requirements. Wastewater treatment sludges are typically concentrated either by lagooning or by physical means such as centrifugation or filter pressing. Because of the large number of constituents in wastewater treatment sludges, recovery and reuse of the sludge constituents is not practiced. Some wastewater treatment sludges are incinerated. The concentrated cyanides, acids, and alkalies are typically oxidized and neutralized by conventional wastewater treatment methods. Most oils and paint wastes are not treated prior to disposal; however, some petroleum distillate oils are recycled.

Off-site reclamation is common for halogenated and non-halogenated solvent wastes and metal scrap. Reclamation of halogenated and non-halogenated solvents ranges from repackaging of slightly contaminated solvents to multiple fractionation procedures for mixed still bottoms; some solvents are also incinerated off-site. Metal scrap, except beryllium oxide wastes, is usually sold to metal reclaimers.

Based upon the study by Wapora, Inc., in 1975 approximately 13 percent of the potentially hazardous wastes were disposed on-site; approximately 66 percent were disposed off-site; and approximately 21 percent were reclaimed. Most of the off-site disposal was by landfill. On-site disposal typically consisted of lagooning of wastewater treatment sludges, dumping of small quantities of potentially hazardous wastes on the facility grounds, and discharges to sanitary sewer systems.

D.3.13 Storage and Primary Batteries Industry. Table D-16 presents typical treatment and disposal practices for the hazardous wastes generated by the storage and primary batteries industries (SIC 3691 and 3692), based upon information reported by Versar, Inc. (1975a). Potentially hazardous waste streams generated by the industry consist of wastewater treatment sludges and rejected and scrap cells.

On-site treatment of potentially hazardous wastes is not usually practiced, except in instances where metals are reclaimed from the

TABLE D-16

TYPICAL HAZARDOUS WASTE HANDLING PROCEDURES
FOR THE STORAGE AND PRIMARY BATTERIES INDUSTRIES*

Hazardous Waste Stream	Treatment by Generator	Preparation for Off-Site Disposal	Reclamation		Disposal	
			On-site	Off-Site	On-Site	Off-Site
Wastewater treatment sludge	some treatment for metal recovery	small quantities placed in steel drums	recovery of metal content	recovery of metal content	landfill; dump	landfill; dump
Rejected and scrap cells	some treatment for metal recovery	not reported	recovery of metal content	recovery of metal content	landfill; dump	landfill; dump

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* Versar, Inc., 1975a.

waste stream. Reclaiming of the metal content is done both on-site and off-site. Metals typically recovered include lead, mercury, silver, and cadmium.

According to Versar, Inc., in 1973 approximately 35 percent of the potentially hazardous wastes were disposed on-site; the remainder were disposed off-site. About 85 percent of the total hazardous wastes were disposed in general purpose landfills (on-site and off-site) which usually did not have special containment, monitoring, or leachate provisions. Most of the remainder was reclaimed or discharged into muncipal sewer systems. In the case of the Weston mercury cell, the disposal practice for rejected and scrap cells was indefinite storage on-site.

APPENDIX E

CHARACTERIZATION OF THE HAZARDOUS WASTE TRANSPORT INDUSTRY

This appendix presents a characterization of the hazardous waste transport industry, based upon information reported by Arthur D. Little, Inc. (1978a). The basic role of the hazardous waste transport industry is to move hazardous wastes from the point of generation to an off-site facility for purposes of storage, treatment, and/or disposal. Hazardous waste transport includes both intrastate and interstate movements and occurs by highway, rail, air, pipelines, and waterway.

Three hazardous waste transport industry segments have been identified by the Arthur D. Little, Inc. study, i.e., generator/transporter, hazardous waste management facility/transporter, and for-hire transporter.

- Generator/transporters are hazardous waste generators who function as private carriers by self-hauling hazardous wastes off-site to hazardous waste management facilities (transport by this segment is invariably by truck).

- Hazardous waste management facility/transporters are operators of hazardous waste management facilities who also function as contract or private carriers in providing transportation from generators to storage, treatment, or disposal facilities (transport by this segment is invariably by truck).

- For-hire transporters are common and contract carriers who transport hazardous wastes (and other property as well) but who do not generate, treat, store, or dispose such wastes (transport by this segment is primarily by truck, but includes rail, waterway, and air).

It should be noted that the three segments combined do not truly constitute a readily identifiable industry in the customary definition of the term. None of the segments, and particularly the generator/transporter, views itself as being part of an industry devoted to hazardous waste transportation. Rather, each views itself as being engaged in an activity (hazardous waste transport) which is a part of a larger set of business activities; each engages in hazardous waste transport because of convenience or economics. Many hazardous waste management facility/transporters provide transportation solely as a convenience to generators; their principal service is waste treatment and disposal. For-hire transporters (e.g., railroads, airlines) are in the business of hauling cargo which is only rarely hazardous waste.

According to the Arthur D. Little, Inc. study, neither the number of firms within each industry segment nor in the industry as a whole is known, nor is the rate of firms entering or leaving the industry. Furthermore, the quantity of hazardous wastes transported annually by the industry is unknown, as is the distribution of waste transport by mode or by industry segment. To illustrate the magnitude of hazardous wastes being transported off-site, based upon the waste quantities in Chapter 6 and the average off-site disposal factor in Table 5-10, there is on the order of 8 to 10 million metric tons of potentially hazardous manufacturing wastes currently being transported off-site on an annual basis. Table E-1 presents a qualitative estimate of the relative amounts of hazardous wastes moved by mode and by industry segment. The vast majority of such wastes are transported by highway with a small amount being transported by rail and even smaller amounts being moved by waterway.

E.1 Generator/Transporter

Reliable data are extremely limited with regard to generator/transporters. Most of the information available on generator/transporters is contained in the Industry Studies (1975-1978) prepared for EPA. About 3.5 percent of the plants inventoried in the Industry Studies transported their own wastes, and less than 3 percent of the total quantity of waste hauled off-site was transported by the generator.

The tendency to self-haul is industry dependent. For example, waste oil re-refiners self-haul over 50 percent of their wastes going off-site while the metal-smelting and refining industry does little or no self-hauling. The limited data available suggest that self-hauling firms tend to be the smaller firms in an industry and tend to be located in rural areas where contractor services are not available. Wastes transported by self-hauling firms are usually transported a distance of under 10 miles, and often are moved no more than 1 to 2 miles.

Plants that self-haul handle only their own wastes; they do not offer waste transport services to other companies. Furthermore, no

TABLE E-1

RELATIVE AMOUNT OF HAZARDOUS WASTES TRANSPORTED OFF-SITE BY MODE AND INDUSTRY SEGMENT*

Mode	Generator/ transporter	Hazardous waste management facility/ transporter	For-hire transporter
Air	None	None	Negligible
Rail	None	None	Small
Highway	Very small	Large	Large
Waterway	None	None	Very small
Pipeline	Negligible	Negligible	None

*Modified from Arthur D. Little, Inc., 1978a.

company with more than one plant is known to provide general waste transport services even to several of its own plants. The decision to self-haul or to use a contractor is generally made at the plant level.

Most self-haulers operate only one waste transport vehicle which, in some cases, is not even dedicated. The vehicle is usually operated by a single driver employed by the plant, though he may be assisted in loading and unloading by plant or disposal site personnel. The transport vehicles used range from general purpose flatbed trucks to 5,000-gallon tank trucks. Table E-2 presents examples of the types of vehicles used for various kinds of wastes and the rate of vehicle utilization.

When waste is transported by tank truck, the vehicle itself serves as the container. When a flatbed is used, wastes may simply be deposited together with other non-hazardous wastes. More often, however, the wastes are loaded into the truck in barrels or in 55-gallon drums.

Wastes that are hauled by generators are typically transported as generated, without treatment, and are usually taken either to a site owned and operated by the company and dedicated specifically to its wastes, or to a general-purpose municipal or private landfill that also handles municipal wastes. When the final destination is a dedicated company-owned site, transport and disposal are handled as part of normal plant operations, with no special pre-notification or

TABLE E-2

EXAMPLES OF TYPES OF VEHICLES USED BY GENERATORS WHO TRANSPORT WASTES*

Industry SIC Code	Type of waste	Type of vehicle	Number of vehicles	Utilization rate
283	Treatment plant sludge (30%) solids)	Tank truck	2 (larger is 5000 gal)	25-30 hauls/week/truck
	Dry solids	Flat bed with tarp cover	25-30	25-30 hauls/week/truck
285	Sludges and paint with municipal trash	Flat bed	1	4 hauls/week
3111	Chrome contaminated leather scrap	Flat bed	1	1 haul/day
	Sludge (3% solids)	2000 gallon tank truck	5	1 haul/day/truck
3292	Asbestos scrap, bag-house wastes, and settling basin sludge	Flat bed (leak proof)	1	1 haul/day
3471	Sludge	1500 gallon tank truck	1	6 hauls/day
355,357	Metal sludges and oil contaminated grindings	Flat bed	1	1 haul/day
	PCB saturated Fuller's earth	Covered trailer truck	2	1 haul/mo/trailer
369	Scrap batteries	2 ton flat bed (covered and leak proof)	1	1 haul/day
5093	Tarry sludges	4000 gallon tank truck	1	1-2 hauls/week

* Arthur D. Little, Inc. 1978a.

acceptance procedures. Company personnel accept the wastes and assist in the unloading, usually directly into a landfill or lagoon.

When the final destination is a municipal or private landfill, prior arrangements are made to assure that the landfill is permitted for the wastes in question and that the landfill's regulations for delivery are followed. Trucks generally submit a copy of the bill of lading to the landfill operator for billing purposes. The quantity of waste delivered is recorded either by weighing or by a volume estimate, and the truck is directed to a dumping area. Marking and labeling practices vary a great deal. There may be no labeling at all other than the company name on the truck in some cases. Many of the companies contacted by Arthur D. Little, Inc. indicated that they followed DOT marking and labeling requirements, but most also indicated that application of DOT requirements to hazardous wastes was ambiguous at times.

Generators, at least the major facilities, do keep records of how much waste is shipped, who carried it, and where it went. Such records are usually kept for a period of at least seven years. Self-haulers transporting to a company-owned site typically prepare a summary report monthly on the quantity of material hauled (Arthur D. Little, Inc., 1978a).

E.2 Hazardous Waste Management Facility/Transporters

In 1977, there were approximately 110 hazardous waste management facilities in the U.S. (Straus, 1977). An estimated 50 to 67 percent of these facilities also transport hazardous wastes (Arthur D. Little, Inc., 1978a; Straus, 1977). Approximately 56 percent of the hazardous waste management/transporters are located in EPA Regions II and V.

Transportation activities of the hazardous waste management/transporters tend to be interstate; 64 percent of the facilities investigated in the Arthur D. Little, Inc. study have interstate transportation capabilities. Further, 56 percent have locations in more than one state or receive waste materials from out of state. Many of the disposer/transporters are thus subject to regulations of more than one jurisdiction as well as those of the Department of Transportation and other Federal agencies.

Those hazardous waste management facility/transporters who operate intrastate tend to serve a relatively small geographical area or section of the state. Those who operate interstate generally operate within one region rather than within several regions. The portion of wastes handled by each type of operation is not known, nor is the portion of the interstate operator's business that is done outside his home state.

With the exception of a few very large companies, the hazardous waste management facility/transporters are privately owned or closely held public corporations. Seventy-four percent of the companies operate ten or fewer vehicles and at least sixty-six percent employ ten or fewer workers in activities directly involved in transportation.

The predominant type of vehicles used are tankers and tank trailers. Flatbeds and vans account for less than 30 percent of the vehicles used by hazardous waste management/transporters.

In general, the transportation vehicles bear an identification of the company and the hazardous nature of the materials being transported. In this respect, most of the facilities follow DOT guidelines. In some instances, state regulations (e.g., California, Texas, Ohio) were cited by hazardous waste management facility/transporters as the controlling factor for marking and describing the nature of the cargo. With respect to labeling, the hazardous waste management facility/transporters indicated that they properly identified the materials contained in drums or barrels; however, many indicated that generators or other transporters either did not take care in labeling or were unaware of the importance of proper labeling.

In terms of the physical movement of the hazardous waste materials, when the hazardous waste containers used are drums or barrels, they are almost always provided by the generator and are loaded onto the transport vehicle by the generator, either by forklift or by hand. When the container is the transport vehicle itself (e.g., tank truck), the hazardous waste management/transporter takes part in the loading; when a vacuum truck is used, the hazardous waste management/transporter does the loading. There is little mixing of materials except as done by the generator; multiple pickups are rare.

Several of the companies contacted by Arthur D. Little, Inc. indicated that they analyze contents either prior to or upon receipt of waste materials. In situations where the generator is unknown or not considered "trustworthy," the hazardous waste management/transporter usually insists on content analysis prior to accepting a job.

Nearly all the facilities contacted keep records which minimally describe the quantity, source, waste type, and delivery point for each transport/disposal job. These records are in various forms and include: billing records (invoices), shipping documents or bills of lading, purchase orders or job tickets, and self initiated or state required manifests. Usually these documents are filed together and are retained for several years, based in part upon requirements by the Interstate Commerce Commission (3-year retention), Internal Revenue (7-year retention), state tax department, and other state agencies (Arthur D. Little, Inc., 1978a).

E.3 For-Hire Transporters

For-hire transporters include common and contract carriers that transport hazardous waste by highway, rail, air, pipeline, and waterway.

E.3.1 Common and Contract Highway Carriers. According to Arthur D. Little, Inc., very few data are available with regard to common and contract highway carriers involved in the transport of hazardous waste, and as a result, it was not possible even to develop a representative sample for study purposes. Thus, the information reported by that study should only be considered as preliminary.

The transporters contacted ranged from firms which have only one business location to firms of national carrier status having sixty or more terminals across the country. Most of the firms have only one location while some have between two and four locations. The firms ranged from having less than 0.1 percent to 100 percent of their business in hazardous waste. Many of the firms contacted offer a complete package that includes transportation and selection of disposal site. A few carried to only one disposal site (typically a local landfill).

About one-half of the for-hire transporters contacted do not transport any hazardous waste across state borders. Others indicated that anywhere from 80 to 100 percent of their hazardous waste transport is interstate. Within those states which required permits for transporting hazardous wastes, the transporters usually indicated statewide service. Smaller transporters tended to see states requiring permits as the practical limit of their service radius. Excluding the national common carriers who provided no estimates, transporters indicated trip distances ranging from 25 to 150 miles with most companies responding at 50 miles. One common carrier indicated that 500 to 600 mile trips were normal.

Quantities of hazardous waste being transported interstate or intrastate could not be identified, nor, in most cases, could the total quantity of hazardous waste being transported by individual companies. The only generalizations which are possible are that:

- Large intrastate common carriers handle significant quantities of hazardous waste, but these are only a very small portion of their overall business (less than 1 percent in most cases).
- Many firms started out handling many kinds of waste, and the "hazardous" label of their business came with existing regulations.

Very sketchy information is available on the nature of the wastes transported. General transporters who handled the following types of waste were identified: liquids/solids/sludges, waste oils, solvents for recycle, general hazardous trash, paint wastes, hydrocarbons, chlorine, acids, cyanide wastes, caustic wastes, hydrogen fluoride, cleaning solutions, and radioactive wastes. Though some general transporters specialize in a particular waste, such as waste oil or spent acid, most handle many kinds of hazardous wastes.

Only one general transporter with its own laboratory for sampling the wastes was identified. About 20 percent of those who responded have an outside laboratory on contract. Most of the general transporters relied totally on the generator to supply any necessary analyses.

Most of the firms contacted primarily handle liquid wastes and, as a result, the majority of the vehicles used for transport are tank trucks; there are a number of vacuum trucks and a considerably smaller number of other vehicles, such as flat bed trucks (for hauling drums), dumpsters, compactors, dump trucks, "roll-off" hopper trucks, vans, and pickups. Some of the national tank carriers have nearly 3,000 tank cars; most firms, however, have between one and 30 trucks.

The capacity of the tank trucks used ranges from 1,200 gallons to 8,600 gallons. Many firms have a fleet with all vehicles of the same size or only a couple of sizes, while others have a wide variety of truck sizes. The flat beds are estimated to carry 35 to 65 drums. Some companies indicated the intent to never stack the drums in more than one level to avoid the increased chances of spillage.

Few requirements are now designated by the transporter for labeling of containers by the generator. Labeling, in most cases, is not rigorously performed. Some generators stencil DOT-type labels on the drums. Others reuse the original drums and cross off the suppliers' names. Some transporters indicated that minimal or incorrect labeling of drums had caused some hazardous incidents.

All large interstate carriers contacted indicated that they use DOT placards and follow ICC regulations. About half the firms contacted do not use placards; however, some of those contacted indicated that they would shortly begin to use placards.

All of the firms contacted keep records. The most common forms for recordkeeping are the bill of lading and the weigh ticket. However, the paperwork which forms the basis for recordkeeping also includes the following: generator bill, invoice, pay-slip, disposal papers, dumping slip, manifest, order request form, and ticket system. The transporters contacted indicated that records were retained for at least five or seven years as a result of state, Internal Revenue Service, and/or Interstate Commerce Commission regulations in addition to general management practice.

These records are used most often for billing purposes, are often requested by the generator, and in many cases are also required to be reported on a monthly or annual basis to state environmental departments. These records, in all cases, identify the date, quantity, source, and delivery point and in most, but not all cases, provide a description of the waste. In those instances where the waste is not well identified, it is usually listed as "miscellaneous processing wastes" (Arthur D. Little, Inc., 1978a).

E.3.2 Rail Transport. The physical and geographical facilities and organizational characteristics of railroads are similar throughout the industry. As common carriers under the ICC, the railroads must accept all cargo tended to them that is properly packaged and labeled. In general, the shipper, not the railroad, accepts responsibility for the condition, description, packaging, and labeling of the material shipped. In fact, one of the most important aspects of the practices and regulations in the transport of hazardous waste by railroad is that the railroad does not directly handle the hazardous waste as such, but only transports rail cars already loaded and ready for delivery. The shipper must provide to the railroad the sealed or closed containers of the hazardous material or waste and certify in the bill of lading that the shipment conforms to regulations. Furthermore, the railroad car in which the containers are placed must be sealed or closed when tended for shipment.

A small amount of hazardous wastes is transported by rail as compared to highway transport. Only a limited number of disposal sites accept hazardous waste by rail, and only a small portion of the total hazardous waste transported by rail is believed to go to such disposal sites; most of it is believed to go to reclamation and recovery facilities. For example, nearly all spent sulfuric acid and petroleum refinery treating wastes transported by rail go to recyclers who have rail sidings on their own property. Furthermore, a small but still significant portion of hazardous waste shipments are believed to be intermodal. These consist of truck pickup or delivery to rail sidings, barge transfer operations, or truck-rail piggyback operations.

Some of the types of potentially hazardous wastes handled by the railroads are listed in the Hazardous Materials Table of the Department of Transportation regulations 49 CFR 172.101. Hazardous wastes that are specifically identified are listed in Table E-3. Estimates of the number of carloads of selected potentially hazardous wastes that were shipped by rail in 1976 are presented in Table E-4.

TABLE E-3

WASTES LISTED IN THE HAZARDOUS MATERIALS TABLE
(49 CFR 172.101)

Acid, sludge
Aluminum dross, wet or hot
Aniline oil drum, empty
Arsenical dust
Arsenical flue dust
Bags, burlap, used*
Bags, sodium nitrate, empty and unwashed
Barrel, empty*
Battery parts (plates, grids, etc.) unwashed, exhausted
Black powder igniters with empty cartridge bag
Bottles, not cleaned*
Burlap bag, used and unwashed, or not cleaned
Burnt cotton, not repicked
Burnt fiber
Carboys, empty*
Cartridge cases, empty, primed
Container, reused or empty*
Cotton batting dross
Cotton waste or sweepings
Cotton waste, oily
Cylinder, empty*
Drums, empty*
Dusts, byproduct, poisonous
Empty cartridge bag with black igniter
Empty cartridge case, primed
Felt, waste
Felt, waste, wet
Fibers, burnt
Flue dust, poisonous
Garbage tankage
Gas drips, hydrocarbon
Grenade, empty, primed
Hair, wet
Iron mass or sponge, spent
Lead dross
Magnesium dross, wet or hot
Magnesium scrap
Metal borings, shavings, turnings, or cuttings
Nickel catalyst, wet, spent
Nitrating acid, spent
Oiled clothing or material
Paper scrap or waste
Propellant explosives in water, unstable, condemned, or deteriorated
Pyroxylin plastic scrap
Rags, oily or wet
Rocket ammunition with empty projectile
Rubber scrap or buffings
Sawdust and wood shavings
Sulfuric acid, spent
Tank car, empty*
Tank, portable, empty*
Tank truck, empty*
Waste paper, wet
Waste textile, wet
Waste wool, wet
Zirconium scrap

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*Previously used for a hazardous material.

TABLE E-4

ESTIMATED ANNUAL CARLOADS OF SELECTED POTENTIALLY HAZARDOUS WASTES CARRIED ON RAILROADS IN 1976*

COMMODITY	CARLOADS
Acid, sludge	94
Battery parts (plates, grids, etc.) unwashed, exhausted	71
Garbage tankage	1
Lead dross	8
Nickel catalyst, wet, spent	1
Nitrating acid, spent	80
Rags, oily or wet	73
Rubber scrap (only as hazardous material)	2
Sulfuric acid, spent	2,965
TOTAL	3,295

*Arthur D. Little, Inc., 1978a.

Most rail shipment of hazardous waste is by tank car. Rail shipment is generally limited to large generators since only such generators are normally capable of filling tank cars which can hold up to 35,000 gallons of liquid wastes. The relative dominance of large generators often results in trips of great distances, normally on the order of hundreds of miles. The Arthur D. Little, Inc. study indicated that there is a great range of reported distances over which hazardous waste is transported (i.e., 6 miles to over 2,000 miles).

The major regulations followed by railroads are the DOT regulations as summarized in CFR Title 49. These regulations identify hazardous materials and stipulate the containerization, handling, loading, and placarding practices, some recordkeeping procedures, and certain safety procedures. The hazardous materials identified by the railroads number over 2,000, of which 1,300 have also been designated as hazardous materials by DOT and assigned to hazard classes. Handling, loading, switching, location within train, and delivery practices are often broken down by hazard class. The DOT regulations for tank cars are such that these vehicles are usually dedicated to hazardous material delivery. Furthermore, each rail car or container offered for shipment must generally be placarded on four sides if the car or container carries a DOT hazardous material.

In addition to DOT regulations, ICC regulations for common carriers and Federal safety standards (Railroad Safety Act of 1970) apply. Military rail traffic is also governed by Joint Service Regulations (in addition to the DOT regulations). Some state and local regulations exist, but are very limited.

The relevant documents for the transport of hazardous waste consist of the bill of lading and the waybill. The bill of lading, which includes such standard information as shipper, consignee, date, description of goods shipped, and routing, is prepared by the shipper when the shipment is offered for transport. For hazardous materials, the DOT regulations (49 CFR 172) require that bills of lading include the proper shipping name, hazard classification, placard notification, the total quantity shipped, and certification that the shipment is in compliance with the DOT regulations. The railroad is ordinarily supposed to accept this certification by the shipper.

The bill of lading is ordinarily presented to the authorized agent of the railroad, and the railroad prepares a waybill for the train crew. The waybill is the document of transit and generally includes the information on the bill of lading plus the standard transportation commodity code and a special endorsement. The waybill is filed at the railroad's destination office upon delivery. If the rail car is moved to a private siding, the crew does not have to possess a copy of the waybill if the move is considered a switch or transfer.

For hazardous materials, a copy of the certified bill of lading must be kept on file by the origin carrier for at least three years, in accordance with ICC regulations. The railroads interviewed in the Arthur D. Little, Inc. study all maintain this shipping data in an internal computer system (Arthur D. Little, Inc., 1978a).

E.3.3 Air Transport. The amount of hazardous waste transported by air is very small, possibly on the order of several tons per year. Small amounts of waste acids, flammable metal shavings, radioactive materials, and laboratory samples of hazardous wastes have been identified as being shipped by air. These wastes are shipped by air because local disposal or neutralization facilities do not exist. The radioactive materials are being returned to the manufacturer for disposal.

The existing regulations for the transport of hazardous waste by air are much more stringent than those applying to other modes. In addition to DOT regulations (49 CFR 175), there are FAA procedures (14 CFR 1-199) and Airline Pilots Association standards (Operation STOP). Recordkeeping, training, and safety practices for hazardous materials are generally derived from these regulations.

The regulations require that copies of shipping papers, prepared by the shipper, must be carried onboard. The originating carrier must then maintain a copy of the shipping paper for 90 days. In addition to shipping papers, the air carrier is to prepare a manifest for the total cargo. Shipments must be labeled according to DOT hazard classes.

Some differences between practices for air transport and other modes of transport are worth noting. The criteria for determining which materials may be shipped are more strict for air than for other modes. Despite this limitation, however, both passengers and some types of hazardous waste can be placed on the same aircraft. The allowable quantities of hazardous materials that may be shipped by air are also a great deal smaller than for other modes. Hazardous materials on air flights generally do not require special placarding, although these materials must be placarded if there is intermodal ground transport (Arthur D. Little Inc., 1978a).

E.3.4 Pipeline Transport. Off-site pipeline transport of hazardous waste is extremely limited. On a national level, there are no major pipelines for transporting wastes; the commercial pipeline industry is almost entirely devoted to the transport of fuel products. Waste transport by pipeline is generally limited to a few concentrated industrial areas in the U.S.

A number of isolated cases of hazardous waste transport by pipeline were identified by the Arthur D. Little, Inc. study (however, these are private pipelines, not for-hire pipelines). Three instances of industrial wastes being transported off-site by pipeline were found; two of these pipelines are in Oklahoma and the third is in Texas. These pipelines are on the order of a half-mile or less in length. In addition, regional sanitary districts sometimes use slurry pipelines for the transport of sludge that contains industrial wastes; for example, the Cleveland Regional Sewer Authority and the Metropolitan Sanitary District of Greater Chicago transport sludge 14 and 30 miles, respectively.

Regulatory control of pipeline waste transport is not uniform and there are few standard practices. At present, CFR Title 49 applies to the pipeline transport of hazardous materials (not necessarily wastes). Whenever a hazardous material is transported, the Secretary of the DOT must be notified in writing. Also, accidents must be reported to the Director, Office of Pipeline Safety. Municipal operations often need local disposal permits for sludge transported by pipeline. There are also state authorities with some limited regulatory control over pipeline transport. In some instances, there may also be other overlapping regulations dealing with transport by pipeline (e.g., Federal Water Pollution Control Act) (Arthur D. Little, Inc., 1978a).

E.3.5 Waterway Transport. The quantity of hazardous waste transported by barge on inland waters appears to be small relative to highway transport.* No vessels other than barges are known to carry hazardous wastes. The barge is normally provided by the barge line, not the generator.

Shipments of hazardous waste move primarily on the Gulf Intracoastal Waterway - Mississippi River System portion of the total inland waterway system in tank barges with a capacity range of 1,200 to 1,500 tons. A typical one-way trip may be on the order of 1,000 or more miles. Most often, the waste transported includes spent acids, spent caustics, and waste glycol. The wastes are generally in liquid bulk form with a water content up to 90 percent and normally are transported to resource recovery facilities.

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*RCRA does not apply to barges transporting wastes for ocean disposal, except with regard to manifesting and recordkeeping.

The barge companies contacted by Arthur D. Little, Inc. indicated that they observe Coast Guard regulations (CFR Title 46) and the Department of Transportation regulations (CFR Title 49). These regulations require general marking and placarding for various types of hazardous materials. Although there is no placard that defines a cargo as "hazardous waste," a number of placards are used that describe the danger associated with the hazardous waste being transported. In addition, red warning flags are positioned strategically on the barge.

The bill of lading, weigh ticket, and shipping manifest papers are the commonly used forms for recordkeeping. The records serve several purposes which include billing, taxes, lost cargo claims, and compliance with regulations. The retention period for records varies considerably among companies interviewed by Arthur D. Little, Inc. The companies stated that records are retained in current files for 5 to 7 years because of legal requirements, as well as administrative procedures.

In addition to the above forms, shipping papers and a dangerous cargo manifest must accompany shipments of hazardous packaged cargo and solids in bulk. The shipping paper must have at least the following information: proper shipping name, hazard class, total quantity of material, and shipper's certification. The dangerous cargo manifest must contain information such as: the name of vessel, official number, nationality of vessel, shipping name of each hazardous material onboard, gross weight, classification of the hazardous material, and stowage location onboard the vessel.

APPENDIX F

POTENTIAL RECOVERY OF SPECIFIC HAZARDOUS WASTES GENERATED BY SELECTED MANUFACTURING INDUSTRIES

F.1 Potential Recovery of Hazardous Wastes Generated by the Inorganic Chemical Industry

A detailed report by Versar, Inc. (1977) on alternatives for hazardous waste management in the inorganic chemicals industry illustrates the complex relationships among resource recovery, waste treatment, and product cost resulting from both technically demonstrated and conceptual alternative treatment systems. Technically demonstrated treatment systems were presented for the mercury cell chlor-alkali industry, the sodium manufacturing industry, and the phosphorus manufacturing industry (Table F-1)*. Each of the treatment systems demonstrated the derived benefits of resource recovery. Comparison of treatment system costs with sanitary landfill costs revealed significantly higher costs associated with resource recovery (Table F-2). However, comparison of treatment costs with the cost of chemical landfill revealed essentially equal costs for one system designed for chlor-alkali plant wastes and cost benefits for recovery of phosphorus from one waste stream of the phosphorus manufacturing industry.

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*In the case of phosphorus manufacturing, several key processing steps have been demonstrated. However, the integrated treatment process has not as yet been technically demonstrated. The sodium recovery process has been used in the past, but has been abandoned due to significant safety hazards.

TABLE F-1

SUMMARY OF TECHNICALLY DEMONSTRATED ALTERNATIVE TREATMENT SYSTEMS FOR WASTES GENERATED BY THE INORGANIC CHEMICAL INDUSTRIES*

Waste Generating Industry	Waste Stream No.	Treatment System		Unit Processes in Treatment Train†								Benefits Derived	Total Treatment Cost $/kkg of Waste		Product Cost Impact $/kkg of Product
		Identification Number	Feed Rate kkg/day	1	2	3	4	5	6	7	8		Wet Basis	Dry Basis	
Chlor-Alkali Mercury Cell	1 & 2	01100	19.5	Neut. C,V	Dis. C,IV	Filt. P,V	Sed. P,V	Preci. C,V	Filt. P,V	Dis. C,V	Neut. C,V	1) Mercury Recovery 2) Waste Reduction 3) Waste Detoxification	89	361	6.9
	1 & 2	01200	19.5	Sed. P,V	Filt. P,V	Calc. C,IV	Post Treat.	—	—	—	—	1) Mercury Recovery 2) Waste Reduction 3) Waste Detoxification	34‡	143‡	2.7
Sodium Mfg.	3	06100	1.82	Pre Treat	Elec C,III	Grind P,V	Dry P,V	—	—	—	—	1) Sodium Recovery 2) Cell Bath Recovery 3) Waste Elimination	—	3,170§	44
Phosphorus Mfg.	4	16B100	18.3	Floc. P,V	Clar. P,V	Phase Sep. P,V	Dist. P,V	Post Treat.	—	—	—	1) Phosphorus Recovery 2) Waste Reduction	12	120	1.6

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*Versar, Inc. 1977.

†All unit processes are listed in the same order as recommended for treatment. Unit processes have been classified using "P" for physical separation and "C" for chemical transformation processes. ADL's categorization of I through V has been used to identify the developmental stage of each unit process used. Legend:

Neut - Neutralization
Dis - Dissolution
Filt - Filtration
Sed - Sedimentation
Preci - Precipitation
Calc - Calcination
Elec - Electrolysis
Grind - Grinding
Clar - Clarification
Dry - Drying
Floc - Flocculation
Sep - Separation
Dist - Distillation

‡Average of systems 01200A and 01200B (multiple hearth vs. fludized bed calcination.

§This waste stream contains no moisture. Therefore the treatment cost is given on dry basis only.

TABLE F-2

COST COMPARISON OF RESOURCE RECOVERY TREATMENT SYSTEMS WITH LANDFILL OPTIONS FOR WASTES GENERATED BY INORGANIC CHEMICAL INDUSTRIES*

Industry	Waste stream number	Capital investment (MM $)			Annual operating costs ($)		
		Treatment system	Sanitary landfill	Chemical landfill	Treatment system	Sanitary landfill	Chemical landfill
Chlor-alkali plants mercury cell operations	1 & 2	1.54	0.171	0.707	626,300	118,890	246,430
	1 & 2	0.66[†]	0.171	0.707	246,360[†]	118,890	246,430
Sodium plants	3	1.409	0.103 (0.010)[‡]	0.152	2,262,600	47,990 (27,220)[‡]	66,460
Phosphorus	4	0.544	0.208	1.702	80,400	400,040	1,189,400

*Versar, Inc., 1977.

[†] Average of systems 01200A and 01200B (multiple hearth vs. fluidized bed calciner).

[‡] Contractor operated sanitary landfill.

F.2 Potential Recovery of Hazardous Wastes Generated by the Organic Chemical Industry

Process Research, Inc. (1977) prepared a study on alternatives for hazardous waste management in the organic chemical, pesticides, and explosives industries. It was reported that nineteen of the twenty-four waste streams studied could be treated in a manner that would result in resource recovery (Table F-3). Considering cost credit for material recovery, three of the waste stream treatment systems could potentially result in net savings: hexaclorobutadiene recovered from perchloroethylene plant wastes, chlorinated hydrocarbons recovered from vinyl chloride monomer plant wastes, and lead oxide recovered from lead alkyl plant wastes.

In addition, comparison of treatment costs with the cost of chemical landfill disposal reveals potential cost benefits could be derived from recovery in the case of seven of the waste streams considered; comparison with incineration reveals potential cost benefits in the case of six waste streams (Table F-4).

F.3 Potential Recovery of Hazardous Wastes Generated by the Metals Smelting and Refining Industries

Calspan Corporation (1977a) prepared a study on alternatives for hazardous waste management in the metals smelting and refining industries. Of the 34 waste streams and treatment systems examined, 15 could be expected to yield recycled materials for further use (Table F-5). Of these 15 treatment systems, six resulted in a potential net

TABLE F-3

SUMMARY OF ALTERNATIVE TREATMENT SYSTEMS FOR WASTE GENERATED BY THE ORGANIC CHEMICALS INDUSTRY*

Stream No.	Product and Typical Plant Size	Waste Stream Components	Waste Generation KKg[†]/yr.	Unit Treatment Process[‡]				Benefits Derived	Total Treatment Cost[§]	
				(1)	(2)	(3)	(4)		$/KKg. Waste	$/KKg. Prod.
1	Perchloroethylene 39,000 KKg/yr.	Hexachlorobutadiene Chlorobenzene Chloroethanes Chlorobutadiene Tars	12,000	(DIS) P, IV	(DIS) P, V			90 Percent reduction in waste. Recovery of Hexachlorobutadiene. Detoxification.	-378.05	-116.32
2	Nitrobenzene 20,000 KKg/yr.	Crude Nitrated Aromatics	50	(SD) P, IV	(HY) C, III	(CAT) C, III		10 Percent reduction in waste. 80 Percent converted to salable product. (Nitrobenzene)	1930.00	4.83
3	Chloromethane 50,000 KKg/yr.	Hexachlorobenzene Hexachlorobutadiene Tars	300	(DIS) P, IV (5) (DIS) P, IV	(CL) C, III	(DIS) P, IV	(NEU) C, V	75 Percent reduction in waste volume. Salable Product (Carbon Tetrachloride)	646.33	3.88
4	Epichlorohydrin 75,000 KKg/yr.	Epichlorohydrin Dichlorohydrin Chloroethers Trichloropropane Tars	4,000	(SE) P, III	(EVAP) P, III	(DIS) P, IV		75 Percent reduction in waste volume. Recovery of Epichlorohydrin.	0.50	0.03
5	Toluene Diisocyanate 27,500 KKg/yr.	Polyurethane Ferric Chloride Isocyanates Tars	558	(HY) C, IV	(DIS) P, IV	(NEU) C, IV	(AL) B, III	Detoxification of waste. Partial waste recovery.	428.14	8.69
6	Vinyl Chloride Monomer 136,000 KKg/yr.	1,2 Dichloroethane 1,1,2 Trichloroethane 1,1,1,2 Tetrachloroethane Tars	1,400	(DIS) P, III	(RED) C, IV	(RED) C, IV		80 Percent reduction in waste volume. Recovery of > 900MT of chlorinated Hydrocarbons.	-0.86	-0.01
7	Lead Alkyls 60,000 KKg/yr.	Lead	30,000	(FIL) P, V	(RED) C, IV	(FIL) P, V	(CAL) C, V	Recovery of lead oxide. Detoxification. Reduction in waste volume.	¶	¶
8	Ethanolamines 14,000 KKg/yr.	Tristhanolamine Tars	1,120	(CENT) P, V	(DIS) P, IV			Recovery of 280MT of TEA. Low energy input.	188.48	15.08
9	Furfural 35,000 KKg/yr.	Sulfuric Acid Tars & Polymers	19,600	SED) P, V	(HY) C, III	(COM) B, V		Recovery of 1000MT Sulfuric Acid. Eliminate landfill. Waste volume reduced 5 percent.	50.38	28.71

TABLE F-3 (Continued)

Stream No.	Product and Typical Plant Size	Waste Stream Components	Waste Generation KKg†/yr.	Unit Treatment Process‡ (1)	(2)	(3)	(4)	Benefits Derived	Total Treatment Cost§ $/KKg, Waste	$/KKg, Prod.
10	Furfural 35,000 KKg/yr.	Fines & Particulates From Stripped Hulls	350	(DIS) P, IV	(HY) C, III	(COM) B, V		Recovery of 158MT/yr. furfural.	Combined with Stream No. 12	
11	Fluorocarbon 80,000 KKg/yr.	Antimony Pentachloride Carbon Tetrachloride Trichlorofluoromethane Organics	18	(RED) C, IV	(DIS)** P, IV			Catalyst recovery. Low energy input.	5556.00	1.25
12	Atrazine 20,930 KKg/yr.	Water Sodium Chloride Insoluble Residues Caustic Cyanuric Acid	224,400	(NEU) C, V	(OX) C, III	(AL) B, II	(EVAP) P, V	Detoxification. Boiler feedwater generated. Salable Product. (Salt)	4.33	48.67
13	Trifluralin 10,009 KKg/yr.	Spent Carbon Fluoroaromatics Intermediates and Solvents	1,150	(C&G) P, V (5) (COM) B, IV	(SE) P, III	(CENT) P, IV	(DIS) P, V	Recovery of 200MT/yr. of Chloroform. Reduction in Waste Volume of 50 percent Moderates energy utilization.	398.70	45.85
14	Malathion 14,000 KKg/yr.	Filter Aid Toluene Insoluble Residues Dimethyl Dithiophosphoric Acid	1,826	(HY) C, V (5) (AL) B, III	(SS) P, IV	(SED) P, V	(COM) B, IV	Recovery of 1MT/day of Toluene, detoxification.	81.00	10.36
15	Malathion 14,000 KKg/yr.	Malathion Toluene Impurities Sodium Hydroxide	14,350++ 350 ●●	(SED) P, V	(RA) P, III	(DIS) P, V		Recovery of Toluene and Malathion. Total reuse of water.	-0.38	-0.39
16	Parathion 20,000 KKg/yr.	Diethylthiophosphoric Acid	2,300	(SED) P, V	(UF) P, II	(FIL) P, V	(COM) B, IV	Recovery of 2000MT/yr. of sulfur Reduction of waste volume.	72.61	8.35
17	Explosives 93,000 KKg/yr.	Activated Carbon Nitrobodies	350++ 200 ●●	(SE) P, III	(DIS) P, IV	(CAL) C, V		Cost savings because of carbon regeneration.	557.77++ 951.00●●	2.05
18	Explosives 30,000 KKg/yr.	Redwater	15,000	(INC) - Tampella Process C, V				Recovery of Sellite Est. @ $780,000.00. 99.5 percent reduction of waste	212.54	106.27
19	Explosives 125,000 KKg/yr.	Waste Explosives	250	(C&G) P, V	(OX) C, IV	(ASL) B, IV	(AD) B, IV	COD reduced 80-97 percent. Recovery of energy. Total destruction of explos.	1486.40§§	2.97§§

* Process Resource Inc., 1977.
†KKg = 1 Metric Ton (MT).
‡See abbreviations at conclusion of table.
§Includes credit for material where applicable. A minus sign indicates a cost credit.
†Includes credit for lead recovery

**Dechlorination
++Wet basis
●●Dry basis
§§Wet oxidation

TABLE F-3 (Concluded)

Unit Treatment Processes

Listed below are the physical, chemical and biological unit treatment processes utilized from the Table F-3. The selection of several unit treatment processes in proper sequence forms an Alternative Treatment process.

Physical (P)

Centrifugation (CENT)
Distillation (DIS)
Evaporation (EVAP)
Filtration (FIL)
Resin Adsorption (RA)
Sedimentation (SED)
Solvent Extraction (SE)
Stream Distillation (SD)
Stream Stripping (SS)
Ultrafiltration (UF)
Crushing and Grinding (C&G)

Chemical (C)

Calcination (CAL) or Incineration (INC)
Catalysis (CAT)
Chlorinolysis (CL)
Hydrolysis (HY)
Neutralization (NEU)
Oxidation (OX) - Includes Chlorination
Ozonation (OZ)
Reduction (RED) - Includes Dechlorination and Dehydrochlorination

Biological (B)

Activated Sludge (ASL)
Aerated Lagoon (AL)
Anaerobic Digestion (AD)
Composting (COM)

Process Categories

The category numbers described below indicate the approximate degree of process development.

No.	Description
II	Process might work in 5-10 years, but needs research effort first.
III	Process appears useful for hazardous waste, but needs development work.
IV	Process is developed but not commonly used for hazardous wastes.
V	Process will be common to most industrial waste processors.

TABLE F-4

COST COMPARISON OF RESOURCE RECOVERY TREATMENT SYSTEMS WITH LANDFILL OR INCINERATION OPTIONS FOR WASTES GENERATED BY THE ORGANIC CHEMICALS, PESTICIDES AND EXPLOSIVES INDUSTRIES*

				Alternative Treatment Processes†				Sanitary Landfill		Chemical Landfill		Incineration	
Stream No.	Product and Typical Plant Size	Waste Stream Components	Waste Generation KKg/year	Cost $/KKg Waste	Cost Impact $/KKg Prod.	Prod. Selling Price $/KKg	Impact on Prod. Selling Price %	Cost $/KKg Waste	Cost Impact $/KKg Prod.	Cost $/KKg Waste	Cost Impact $/KKg Prod.	Cost $/KKg Waste	Cost Impact $/KKg Prod.
1	Perchloroethylene 39,000 KKg/yr.	Hexachlorobutadiene Chlorobenzenes Chloroethanes Chlorobutadiene Tars	12,000	-378.05	-116.32	390.00	-29.8	10.00	3.15	48.00	16.00	34.95	10.75
2	Nitrobenzene 20,000 KKg/yr.	Crude Nitrated Aromatics	50	1,930.00	4.83	510.00	0.95	98.00	0.24	157.00	0.39	N.A.	N.A.
3	Chloromethane 50,000 KKg/yr.	Hexachlorobenzene Hexchlorobutadiene Tars	300	646.33	3.88	320.00	1.21	97.00	0.58	128.00	0.77	226.00‡	1.40‡
4	Epichlorohydrin 75,000 KKg/yr.	Epichlorohydrin Dichlorohydrin Choroethers Trichloropropane Tars	4,000	0.50	0.03	882.00	0.003	17.00	0.92	55.00	2.90	55.00	3.00
5	Toluene Diisocyanate 27,500 KKg/yr.	Polyurethane Ferric Chloride Isocyanates Tars	558	428.14	8.69	1,124.00	0.77	97.00	2.08	156.00	3.34	234.00	5.00
6	Vinyl Chloride Monomer 136,000 KKg/yr.	1,2 Dichloroethane 1,1,2 Trichloroethane 1,1,1,2 Tetrachloroethane Tars	1,400	-0.86	-0.01	300.00	0.003	17.00	0.25	67.00	0.94	136.00	1.40
7	Maleic Anhydride 11,000 KKg/yr.	Maleic Anhydride Fumaric Acid Chromogenic Compounds Tars	333	---	---	810.00	N.A.	98.00	2.95	166.00	5.02	323.00	10.00
8	Lead Alkyls 60,000 KKg/yr.	Lead	30,000	-47.18	21.59	1,440.00	-1.64	7.00	3.51	61.00	31.00	N.A.	N.A.
9	Ethanolamines 14,000 KKg/yr.	Triethanolamine Tars	1,120	188.48	15.08	790.00	1.91	18.00	1.40	77.00	6.18	102.00	8.00
10	Furfural 35,000 KKg/yr.	Sulfuric Acid Tars and Polymers	19,600	50.38	28.71	1,035.00	2.77	8.00	4.46	76.00	43.00	9.00	5.00
11	Furfural 35,000 KKg/yr.	Fines & Particulates From Stripped Hulls	350	Included in Stream No. 12			---	---	---	---	---	95.00	0.95
12	Fluorocarbon 80,000 KKg/yr.	Antimony Pentachloride Carbon Tetrachloride Trichlorofluoromethane Organics	18	5,556.00	1.25	1,080.00	0.12 0.01	98.00	0.02	117.00	0.03	N.A.	N.A.
13	Atrazine 20,000 KKg/yr.	Water Sodium Chloride Insoluble Residues Caustic Cyanuric Acid	224,600	4.33	48.67	4,295.00	1.13	6.00	71.00	N.A.	N.A.	N.A.	N.A.
14	Trifluralin 10,000 KKg/yr.	Spent Carbon Fluoroaromatics Intermediates and Solvents	1,150	198.70	45.85	12,290.00	0.37	18.00	2.06	326.00	38.00	104.00	12.00
15	Malathion 14,000 KKg/yr.	Filter Aid Toluene Insoluble Residues Dimethyl Dithiophosphoric Acid	1,826	81.00	10.56	2,090.00	0.51	18.00	1.80	326.00	43.00	75.00	9.50
16	Malathion 14,000 KKg/yr.	Malathion Toluene Impurities Sodium Hydroxide	14,350§ 350¶	-0.38	-0.39	2,090.00	-0.019	18.00	0.40	76.00	1.90	22.50§ 167.00¶	26.00
17	Parathion 20,000 KKg/yr.	Diethylthiophosphoric Acid	2,300	72.61	8.35	1,918.00	0.44	17.00	7.00	70.00	8.00	57.50**	6.50**
18	Explosives 93,000 KKg/yr.	Activated Carbon Nitrobodies	350§ 200¶	557.77 951.00	2.05	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	657.00§,* 1,120.00¶,**	2.50**
19	Explosives 40,000 KKg/yr.	Redwater Nitrobodies of DNT	15,000	212.55	106.27	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	183.00	91.50
20	Explosives 125,000 KKg/yr.	Waste Explosives	250	1,486.40	2.97	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	895.00	2.00

*Process Research, Inc., 1977.

† Includes credit for materials recovery where applicable. A minus sign indicates a cost credit.

‡ One Shift Per Day.

§ Wet.

¶ Dry.

** Two Shifts Per Day.

TABLE F-5

SUMMARY OF ALTERNATIVE TREATMENT SYSTEMS FOR WASTE GENERATED
BY THE METALS SMELTING AND REFINING INDUSTRIES*

Waste Stream	No.	Alternative Treatment		Development Stage‡	Benefits Derived	$/Metric Ton of Waste				$/Metric Ton of Product	
		Process	Process Category†			Wet		Dry			
						Total	Net	Total	Net	Total	Net*
Iron and Steel Prod. - Basic Oxygen Furnace - Wet Emission Control Unit Sludge	1	Reduction Roasting	C	V	Ferric oxide recovery for recycle. Lead and zinc oxide recovery for sale.	$12.66	$ 7.36	$ 29.90	$ 17.40	$ 0.48	$ 0.28
Iron and Steel Prod. - Open Hearth Furnace - Emission Control Dust	2	Reduction Roasting	C	V	Ferric oxide recovery for recycle. Lead and zinc oxide recovery for sale.	12.66	7.36	29.90	17.40	0.48	0.28
Iron and Steel Prod. - Electric Furnace - Wet Emission Control Sludge	3	Reduction Roasting	C	V	Ferric oxide recovery for recycle. Lead and zinc oxide recovery for sale.	12.66	7.36	29.90	17.40	0.48	0.28
Iron and Steel Prod. - Rolling Mill Sludge	4	Sintering	P	V	Iron recovery for recycle.	6.46	1.45	16.25	3.65	0.03	0.006
Iron and Steel Prod. - Cold Rolling Mill - Waste Pickle liquor - Sulfuric Acid (H_2SO_4)	5A	Precipitation	C	III	Ferric chloride for sale. Calcium sulfate (gypsum) for chemical landfill.	55.54	43.31	1,365.82	1,065.24	6.24	4.87
Iron and Steel Prod. - Cold Rolling Mill - Waste Pickle Liquor-Hydrochloric Acid (HCl)	5B	Volatilization	P	IV	Hydrochloric acid recovered for recycle.	38.38	24.80	449.78	290.63	2.06	1.33
		Reduction Roasting	C	IV	Ferric oxide recovered for reuse.						
Ferroalloys - Silicomanganese Manufacture - Slag and Scrubber Sludge	6	Reduction Roasting	C	IV	Ferro and silicomanganese for recycle.	20.36	18.79	50.80	46.88	15.07	13.91

TABLE F-5 (concluded)

		Alternative Treatment				$/Metric Ton of Waste				$/Metric Ton of Product	
						Wet		Dry			
Waste Stream	No.	Process	Process Category[†]	Development Stage[‡]	Benefits Derived	Total	Net	Total	Net	Total	Net
Ferroalloys - Ferro-manganese Manufacture - Slag and Sludge	7	Reduction Roasting	C	IV	Lead and zinc oxide for sale.	$20.36	$18.79	$ 50.80	$ 46.88	$15.07	$13.91
Lead Smelting - Sludge	8	Sintering	P	V	Lead recycled for reprocessing.	6.80	1.01[§]	22.61	3.36[§]	1.34	0.20[§]
Electrolytic Zinc Manufacture	9	Precipitation	C	V	Zinc recycled for reprocessing.	16.81	3.50[§]	56.25	11.20[§]	1.46	0.29[§]
Pyrometallurgical Zinc Manufacture - Sludges - Primary Gas Cleaning and Acid Plant Blowdown	10	Sintering	P	V	Zinc recycled for reuse.	3.56	15.44[§]	11.78	51.08[§]	1.43	6.21[§]
Aluminum Manufacture - Scrubber Sludges	11	Cryolite Recovery	P,C	V	Cryolite	35.09	18.35[§]	27.63	40.59[§]	13.65	7.14[§]
Aluminum Manufacture - Spent Potliners and Skimmings	12	Cryolite Recovery	P,C	V	Cryolite recovered for reuse.	35.09	18.35[§]	27.63	40.59[§]	13.65	7.14[§]
Titanium Manufacture - Chlorinator Condensor Sludge	13	Centrifuge Dewatering Recycling	P	III	Titanium dioxide (rutile) and carbon recovered for reuse.	12.53	14.85[§]	31.59	37.41[§]	10.39	12.31[§]
Aluminum Refining - High Salt Slag	14	Crushing & Screening, Dewatering & Drying	P	IV	Aluminum oxide recovered for reuse.	N.A.	N.A.	47.89	26.02	67.04	36.43
		Dissolution Evaporation Dewatering Drying	P,C	IV	Flux salts, sodium and potassium chloride.						

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[*] Calspan Corporation, 1977a.

[†] Alternative Treatment Unit Process Category: P - Physical, C - Chemical

[‡] Alternative Treatment Stage of Development:
III - Process appears useful for hazardous wastes but needs development work.
IV - Process is developed but not commonly used for hazardous wastes.
V - Process common to most industrial waste processors.

[§] Net gain, i.e., value of recovered material exceeds cost of alternative treatment.

gain due to the cost credit of recovered materials: lead from lead smelting sludge; recycled zinc from electrolytic zinc manufacturing; recycled zinc from pyrometallurgical zinc manufacture sludges and other waste streams; cryolite from aluminum manufacturing scrubber sludges; recycled cryolite from aluminum manufacturing spent pot-liners and skimmings; and titanium dioxide and carbon from titanium manufacturing chlorinator condenser sludge.

Comparison of treatment costs with the landfill option reveals that in nearly all cases the value of metals or salts recovered could more than offset the cost of either chemical or sanitary landfill disposal (Table F-6).

TABLE F-6

COST COMPARISON OF RESOURCE RECOVERY TREATMENT SYSTEMS WITH LANDFILL OPTIONS FOR WASTES GENERATED BY THE METAL SMELTING AND REFINING INDUSTRIES*

Waste Stream	Number	Sanitary Landfill With Contain.	Chemical Landfill	Alternative Treatment Process	
				Total	Net
Iron and Steel Production Basic Oxygen Furnace - Wet Emission Control Unit Sludge	1	3.83	4.35	0.74	0.43†
Iron and Steel Production - Open Hearth Furnace - Emission Control Dust	2	3.83	4.35	0.74	0.43†
Iron and Steel Production - Electric Furnace - Wet Emission Control Sludge	3	3.83	4.35	0.74	0.43†
Iron and Steel Production - Rolling Mill Sludge	4	4.40	4.80	0.60	0.12
Iron and Steel Production - Cold Rolling Mill - Waste Pickle Liquor - Sulfuric Acid (H_2SO_4)	5A	5.98	6.19	4.88	3.80
Iron and Steel Production - Cold Rolling Mill - Waste Pickle Liquor - Hydrochloric Acid (HCl)	5B	5.97	6.16	3.38	2.18
Ferroalloys - Ferrosilicon Manufacture - Slag	6	N.A.	1.20	0.53	0.40†

TABLE F-6 (Concluded)

Waste Stream	Number	Sanitary Landfill With Contain.	Chemical Landfill	Alternative Treatment Process	
				Total	Net
Ferroalloys - Silicomanganese Manufacture - Slag and Scrubber Sludge	7	2.70	3.45	1.02	0.95
Ferroalloys - Ferromanganese Manufacture - Slag and Sludge	8	2.70	3.45	1.02	0.95
Lead Smelting - Sludge	9	5.99	6.19	0.65†	†,‡
Electrolytic Zinc Manufacture	10	5.03	5.22	1.40	†,‡
Pyrometallurgical Zinc Manufacture - Sludges - Primary Gas Cleaning and Acid Plant Blowdown	11	5.99	6.19	0.40	†,‡
Aluminum Manufacture - Scrubber Sludges	12	5.20	5.54	3.49	†,‡
Aluminum Manufacture - Spent Potliners and Skimmings	13	5.20	5.54	3.49	†,‡
Titanium Manufacture - Chlorinator Condenser Sludge	14	4.29	4.53	0.08	†,‡
Aluminum Refining - High Salt Slag	15	N.A.	1.20	6.38	3.47

*Calspan Corporation, 1977a.

†Least cost alternative.

‡Denotes that the alternative treatment process results in a net gain.

APPENDIX G

INDUSTRIAL WASTE CLEARINGHOUSES AND EXCHANGES

This appendix describes the role and operation of industrial waste clearinghouses and exchanges in resource recovery activities. The conceptual differences between the services offered by clearinghouses and exchanges was stated succinctly in a report by Arthur D. Little, Inc. (1976). The services performed by information clearinghouses are described as follows (see also Table G-1):

> "The basic service provided by an information clearinghouse is simple and limited. Action begins when a generator sends to the clearinghouse its offer of a waste which it thinks may have scrap value. (Similarly, a user may initiate action by sending his request for needed scrap material.) The clearinghouse then publishes generator's offer among others in its next regular list. A user scanning this list may be interested by the generator's waste, because he sees in it scrap material of value for his manufacturing process. Because the offer is identified only by code number, user next contacts clearinghouse to register his interest in learning more. As clearinghouse passes user's name on to generator, it completes its service. It thus satisfies one of the requirements for a transfer--linking two potential trading partners;
>
> From then on, the clearinghouse plays no further role. Generator and user negotiate directly to discover whether the many other requirements for a transfer--for example, acceptable purity requirements, price, transportation costs, and mutual confidence--are already satisfied or can be arranged. If so, generator will transfer its waste to user directly;
>
> The clearinghouse generally does not actively try to help satisfy requirements other than introducing potential transfer partners. Thus, the role of the clearinghouse is only passive. It exists to perform only limited functions--to help generators advertise the existence of wastes with possible reuse value, to help users identify such scrap wastes, and to refer potential partners to each other. All other requirements for a transfer must be satisfied by others--sometimes by generators and users themselves, and sometimes by dealers or waste reprocessors."

TABLE G-1

COMPARISON OF CLEARINGHOUSES AND EXCHANGES*

DESCRIPTION	INFORMATION CLEARINGHOUSE	MATERIALS EXCHANGE
Current Examples (described in Appendices A & B)	European and St. Louis Clearinghouses	Wimborne-CPR Zero Waste Systems
	I. SERVICES	
• Services Offered	Information and referral only.	Buy chemical residues, identify potential users, reprocess as needed, and sell at profit; information and referral only as courtesy, or as part of paid consulting services.
• Role & Strategy	Passive-no assistance in negotiating final matches.	Active-Business success depends on brokering match to completion.
• Geographic Area	No limit; broader coverage increases utility of lists to clients.	Transport costs limit most transfers to radius of about 50 miles.
• Industries Served	Mainly chemical.	May be limited, based on special skills, or extensive, to seek more stable volume of activity.
• Scrap Wastes Accepted	All wastes with conceivable reuse value.	Only wastes highly likely to be transferable.
	II. OPERATIONS	
• Volume & Regularity	Begin with moderate and variable level, but may later slow to small and episodic; small, part-time, flexible staff makes variations acceptable.	Begin with limited activity to develop reputation, market, and reprocessing capacities; maintaining constant volume important to use staff and facilities efficiently.
• Advertising	Periodic bulletins to house mailing list; journal ads also possible.	Aggressive personal marketing to supplement brochures and word-of-mouth needed to spot opportunities and overcome client reluctance.
• Data Bank	Simple card files workable to begin; computerizable punched-card system will allow upgrading to computer later as volume grows.	Same, but more data for each material; broad industrial contacts are essential sources.
• Facilities	Only part-time office space; access to association news bulletin helpful.	Lab for analysis, tanks and equipment for reprocessing, storage yard, own or lease trucks; secondhand gear reduces capital cost.
• Network	Cooperation among clearinghouses, by publishing each other's lists, broadens geographic and industry coverage.	Inter-regional cooperation possible, but limited by competition for most profitable scrap materials.

TABLE G-1 (Concluded)

DESCRIPTION	INFORMATION CLEARINGHOUSE	MATERIALS EXCHANGE
	III. STAFF	
• Skills and Experience	Only managerial and clerical essential, but some industry and chemical knowledge desirable.	Chemicals analysis, materials-handling, detailed industry knowledge, technical imagination, marketing entrepreneurship, and business management; access to legal skills.
• Size	Minimum: Part-time manager and secretary, with access to technical advisors. Maximum: Dependent upon volume and fees.	1-6 full-time with business and technical skills; clerical and day labor staff as volume requires.
• Style of Management	Only reactive.	Entrepreneurial, aggressive.
• Initiative to Create Organization	Group, association, with approval of top management.	Mainly individual, by risk-taking entrepreneurs.
	IV. FINANCIAL	
• Pricing Policy	Free, if subsidized; small listing fee acceptable to clients; later, clients may also accept larger subscription fee.	Negotiated for each waste, with likely minimum of $250. "Loss Leader" pricing possible at beginning to establish reputation.
• Income Sources	At first, subsides from sponsor; later, fees from clients.	Capital from investors or parent company; fees from clients.
• Initial Captial Required	None, if office and publication available.	$200,000-$250,000.
• Annual Operating Budget	$10,000-$50,000.	$50,000-$150,000.
• Risks Acceptable	Little or none; sponsor's interest is in preserving its reputation.	Considerable risks necessary.
	V. LEGAL	
• Organizational Form	Small staff unit of sponsor, or agency funded by sponsor.	Independent, small, specialized company; or subsidiary of a large, multi-service company.
• Sponsorship	Industry association typical and preferred. Government possible only if client confidentiality guaranteed; state or federal environmental agencies more likely than local or special governments.	Private investors or parent company.
• Government Regulation of Waste Disposal	Helpful, but not essential for a subsidized service, the stricter, the better for a self-supporting one.	The stricter, the better, to create and stabilize market demand.
• Liability	Concern for generators, but not clearinghouse.	As owner and treater of material, exchange exposed to suit.
• Laws Affecting Transfer Organizations	Same as those for any information or research services	Same as those for any chemical hauler, treater, or reclaimer.

*Arthur D. Little, 1976.

Whereas the services offered by material exchangers is discussed as follows:

> "In contrast to the simple linkage function performed by an information clearinghouse, the services offered by a waste materials exchange are several and complex. As an active dealer in touch with the chemical industries, an exchange identifies potential uses and users, buys or accepts wastes in which it sees value, reprocesses them as necessary (perhaps by chemical treatment, perhaps by consolidating or dividing batches), convinces users of their value, and sells them at a profit;
>
> Whereas the role of the clearinghouse is passive, that of the materials exchange is active. All existing exchanges are profit-seeking firms. They can survive economically only by searching vigorously for transfer opportunities and completing them successfully. Instead of stepping back from negotiation after introducing generator and user, the materials exchange remains interposed between them. As in stock and commodity exchanges, the two trading partners do not know or deal with each other directly, but only via the middleman or broker. Therefore, the items transferred pass physically, economically, and legally through the hands of the exchanger, which earns its income from commissions charged on completed transactions;
>
> It follows from the larger role played by the materials exchange that its organization and economics must be more complex than those of the information clearinghouse. For example, a user must know whether a scrap waste has the chemical and physical properties compatible with his intended use. But a generator typically does not know enough in detail about these properties, often because several wastes from several chemical processes have been mixed; moreover, sufficient analysis can be done only with the potential use in mind. Thus, the materials exchange must operate or contract for laboratory services to analyze the waste. In almost all cases, except for the unusual and ideal case when generator's waste exactly fits user's need "as is," the exchange must process or arrange for processing the material. Moreover, the user wants assurance about the scrap waste's characteristics, sometimes from a legally-binding certificate backed by the exchange's business reputation."

In the past few years, because of increased interest in resource recovery, information clearinghouses have been started in many areas.

These may be public, private, or a combination of both. In some instances, a state now contracts with a private organization to provide the service.

Industrial waste clearinghouses and/or exchanges are currently operating in the states of California, Texas, Iowa, Illinois, Missouri, Minnesota, Georgia, Tennessee, New York, and Massachusetts. The importance of this type of operation can be seen by examining some specific examples.

G.1 Iowa Industrial Waste Information Exchange

The program in Iowa is coordinated with the Iowa State University Center for Industrial Research and Service (CIRAS). It was put in operation on January 1, 1976. This clearinghouse lists available wastes and wanted materials on a periodic basis. Confidentiality is observed. This system operates almost solely in the state of Iowa, although the staff indicates their belief in the need for a national system. About 160 materials have been listed from 118 companies, and more than 450 inquiries have been made with about 25 transactions having taken place over a two-year period. The types of waste listed are scrap stock, waste wood products, paints, steel drums, paper productions, oils, plastics, and chemicals. Table G-2 gives a general breakdown by quantity. Assuming that the fly ash is generated primarily by utilities, this listing of hazardous wastes available represents two percent of the total industrial hazardous waste generated in the state of Iowa. The percentage of materials listed for

TABLE G-2

APPROXIMATE QUANTITIES OF HAZARDOUS WASTE LISTED ON THE IOWA INDUSTRIAL WASTE INFORMATION EXCHANGE IN 1976 AND 1977*

Waste	Quantity (metric tons/year)
Fly ash dusts	260,000
Acid	5,100
Plastics	700
Inorganics	270
Oils	240
Hazardous metals	110
Organics	10
TOTAL	266,430

*State of Iowa, 1977.

which transactions were made was approximately 15 percent. This number is not greatly different from the long-term experiences of the older European clearinghouses, suggesting that about 10 percent of the scrap wastes listed will be actually transferred (Arthur D. Little, Inc., 1976).

G.2 California Industrial Waste Information Exchange

An information exchange program established by the California Department of Health, Vector Control and Waste Management Unit, has grown very rapidly due to enthusiastic industrial participation. The program assists manufacturers in solving their disposal problems in some cases by offering income from an unexpected source and in other cases by reducing the amount of money spent on disposal fees.

As the California program progressed, it became apparent that the recovery and reuse of liquid and hazardous wastes are not well documented, but that the potential is there. In addition, it was found that many times industry needs guidance. Solvent recovery, for example, is immensely simplified if the various kinds of solvents are collected separately rather than combined in one waste storage tank. Thus, hydrocarbons should be collected separately from chlorinated solvents; alcohols and ketones separately from aromatics, etc. The storage equipment costs are quickly amortized by the value received for the used solvents (State of California, 1977).

Many of the informational and educational benefits of the California system have been derived through personal interviews with industry representatives. A case in point is a drum company that cleans, reconditions, and repaints metal drums. The company uses about 7,000 gallons of toluene per month, on a once through basis, for paint removal. The waste stream was composed of toluene and paint sludge, both of which were discharged at a Class I site. Through the clearinghouse interview, it was pointed out that the toluene could be recovered by tolling it out to a solvent recovery unit that would repurify and return it for about one-third the cost of new toluene. This left only the paint sludge to be disposed of at nominal cost (State of California, 1977).

Examples of this type have become manifold now that California has instituted a one-man effort to return industrial waste streams into useful applications. It appears that a low-key state controlled waste brokerage office could be greatly instrumental in reducing the tremendous amount of wastes that are now being burned or going into disposal sites (Personal Communication, Schwarzer, 1977).

For instance, 50,000 tons of diatomaceous earth were located in a waste stream from a sugar company in the San Francisco Bay area. In another interview, a cement company was able to learn of such a large source of material used in their process. Another firm that makes pipe insulation and is contemplating a move was also gratified to learn of this raw material (State of California, 1977).

A pigment company produces 200 to 300 tons per month of high purity iron oxide and discharges it because its color tone does not qualify the materials as pigment grade oxide. A local oil company that makes iron oxide containing catalysts is interested in this waste because of its high quality; a cement company is interested because iron oxide is used in making cement; and an agricultural chemical company is interested since iron salts and zinc salts are valuable for agricultural purposes (State of California, 1977).

These examples demonstrate the ways in which clearinghouses and exchanges can make a contribution to resource recovery and also illustrate that as more information is gathered, the opportunity increases for matching waste streams with companies that can use them.

California estimates that in order to implement a low-key, but effective recycling team, a minimum of four to six technically trained personnel would be needed to cover the technically developed portions of the State. This team would be used to gather data and increase the knowledge of the industrial processes and their effluents within the State (State of California, 1977).

G.3 National Clearinghouses

It is widely believed that clearinghouses can be expanded on a national scale. This would likely require the use of computer technology. The only computer based clearinghouse program currently known to be in existence is that carried out by the state of Minnesota in conjunction with TECHNOTEC, a service of Control Data Corporation. There are now over 4,000 entries on file in the computer. As with the other clearinghouses, there is no record of transactions. However, these data could be retained and would represent a viable means of determining supply and demand.

APPENDIX H

METHODOLOGY FOR THE DERIVATION OF HAZARDOUS WASTE GENERATION FACTORS

H.1 Methods of Quantifying Hazardous Wastes

Since direct determination of the quantity of hazardous wastes generated in the United States is presently infeasible, estimates must be made based on extrapolations from the portion of wastes for which data are available. There are several extrapolation methods which have been considered. Most such methods are based on the amount of hazardous wastes generated either per quantity of product produced, value added, number of production employees, or total employment of individual establishments whose waste generation is known. In addition, some previous studies have conducted surveys to estimate hazardous waste generation within the survey group and have then extrapolated total hazardous waste generation based upon the portion of establishments surveyed. With each of these methods, generators may be grouped by industry type in various levels ranging from very specific categories, such as establishments manufacturing inorganic pigments, to quite broad categories, such as all establishments manufacturing chemicals and allied products. Each method of extra polation has both advantages and disadvantages in terms of accuracy, ease of use, and the amount and availability of data required. As expected, the accuracy of any particular method is a function of the amount and quality of the available data.

The more accurate methods, such as those involving estimates based upon the amount of product produced by specific processes or industries, are practical only in cases involving small, well-studied areas for which the required data can be easily and reliably gathered. Such was the case in a study prepared for the Minneapolis-St. Paul area (Barr Engineering Co., 1973). However, several problems arise when such methods are extended to cover large areas. Production data and costs are usually considered proprietary and are, therefore, difficult to obtain on a scale large enough to extend to a state level, let alone to the national level. In addition, the manufacturing processes used to produce a single product may vary considerably, affecting both the amount of waste generated and the waste characteristics. At the same time, the number of products that must be considered becomes large as the study area is expanded and therefore includes a greater diversity of industries. Use of these techniques also often precludes the aggregation of similar industries using different processes, thus resulting in the need for formidable data handling capability.

The methods that have been most commonly used in previous state surveys involve extrapolation by number of establishments or by number of employees. These surveys generally gathered data through direct contact by letter, telephone, and/or site visit with a representative portion of companies in each major industry group, usually categorized by Standard Industrial Classification (SIC) code. This was done at a number of different resolutions (i.e., two-digit, three-digit, or four-digit SIC code levels), depending on the individual survey. Some surveys mixed levels to use more detailed resolutions for the larger industry groups in particular states. Some states, e.g., Kansas (State of Kansas, 1977) and Rhode Island (State of Rhode Island, 1977), estimated the total hazardous waste production in the state by extrapolation based on the number of industries surveyed in each SIC group. While this technique may be suitable for some areas which have surveyed a representative cross-section of each industry, the variation in company sizes and, hence, waste production, and the tendency for surveys to contact the larger companies in an industry, generally result in excessive errors when extrapolating over a large area based on a small sample.

The majority of previous reports attempting to perform a comprehensive waste survey have used the number of employees as a basis for extrapolation from individual company data to state-wide waste volumes (e.g., State of Washington, 1974; Stradley et al., 1975; Fennelly et al., 1976; and Battelle, Pacific Northwest Laboratories, 1977). Although use of the number of production employees might provide a more accurate extrapolation, lack of appropriate data dictated the use of an extrapolation based on total employees in all of the studies cited above. Usually, the statewide studies grouped industries using a mixture of two, three, and four-digit SIC codes, using the more detailed levels for the larger industry groups in the state. In some cases, industry groupings were made which combined different SIC codes.

For the purposes of estimating hazardous waste generation throughout the country, it was decided to use an extrapolation based on the total number of employees, since the available data in the literature were more realistically adaptable to that method than to any of the other methods discussed above. Estimation of hazardous wastes was necessarily limited to manufacturing industries categorized by the two-digit SIC codes 20 - 39, with the exception of SIC 21 -- Tobacco Manufacturers -- due to a nearly complete lack of data for this highly regionalized industry. Some of the implications of this approach are discussed in a later section of this appendix.

H.2 Data Sources

Hazardous waste generation factors were developed at the two-digit SIC code level using data from five state survey reports, a survey of EPA Region X, a list of hazardous waste disposal permits from Illinois, a computerized industrial waste inventory from Maryland, and unpublished data from state files in Texas. The criteria used for evaluating state data were:

- The definitions or criteria for inclusion of wastes had to be compatible with those of the Subtitle C regulations.
- The survey data had to be categorized by SIC code and be amenable to aggregation at the two-digit SIC level.
- The survey had to either include the number of employees represented by the reported wastes, or alternatively, the wastes surveyed had to represent the majority of the wastes generated in the state.

The states for which data were available and which met these criteria were Illinois, Kansas, Maryland, Massachusetts, Minnesota, Mississippi, Texas, and Washington. In addition, a study of wastes generated in EPA Region X supplied useful data for a few SIC groups. Although these sources all met the criteria, there were significant differences in the goals and methods used in the various studies, resulting in differences in definition, waste exclusions, and other factors which affect their comparability, as discussed below.

Illinois presently has a hazardous waste program in operation for all waste disposal operations, including on-site facilities. Permits are required for the disposal of all special wastes which are defined as "any industrial process effluent, pollution control residual or hazardous waste, including all liquid waste, sludges, and wastes likely to cause fire." Hazardous waste is defined as "any refuse that, of itself or in combination with any other substance, is harmful or potentially harmful to human health or the environment and in conformance with state criteria...[and which] requires special waste management techniques due to its toxic, volatile [flammable], corrosive, explosive, carcinogenic, reactive, pathological, or radioactive nature" (Personal communication, S. Miller, Illinois Environmental Protection Agency, 1977). The 1977 list of special waste disposal permits was estimated by state officials to account for approximately 80 percent of the hazardous waste generated in the state. The permits were categorized by industry type, generally corresponding to the SIC code classification, with the following exceptions: data for SIC code 20 include wastes generated in SIC codes 01, 02, and 09; data for SIC codes 22 and 23 were combined, as were SIC codes 24, 26, and 27. The latter were not used for the nationwide generation factors. In addition, data for SIC 28 included SIC 291; and SIC 29 included SIC 289. There were 679 permits listed in 1977, 85 of which were for non-manufacturing industries (SIC codes other than 20-39). The 1972 Census of Manufacturers listed 18,600 manufacturing establishments in SIC codes 20-39 in Illinois (U.S. Department of Commerce, 1976).

Beginning in 1975, the Kansas Department of Health and Environment conducted a survey of hazardous wastes based on on-site interviews at 396 facilities, or 9.2 percent of the 4,306 facilities listed in the Kansas Directory of Manufacturers. The survey was conducted at the three-digit SIC level and covered 87,500 employees. Wastes were considered hazardous if they contained any of the hazardous constituents included on a list derived from several previous hazardous waste studies performed around the country. Wastes which were covered by NPDES permits were excluded. The study concentrated on industries listed by EPA as potential hazardous waste generators, based on NPDES permit description and air emission records in Kansas files. The survey excluded numerous three-digit manufacturing SIC codes that were not considered to contain potential generators (State of Kansas, 1977).

Data from Maryland were based on a computerized listing of industrial wastes generated within the state. The information was developed by phone, by mail, and through personal visits with 731 out of 2,877 manufacturing firms, representing 180,600 out of 235,000 (77 percent) employees in SIC codes 20-39. The survey delineated 14 waste classifications: solvent, acid, caustic, cleaning wastewater, oil, inorganic solid, organic solid, inorganic liquid, organic liquid, mixed chemical liquid, inorganic sludge, organic sludge, mixed chemical sludge, and mixed chemical solid. It was noted that "specific waste streams in these categories represent various degrees of 'hazard,' depending upon their constituents" (State of Maryland, 1977). Cleaning wastewater made up 58 percent of the total waste reported for the state. In addition, it was noted that the wastes reported for SIC 20 (Food and Kindred Products) contained much organic matter which was not necessarily hazardous. Similarly, wastes reported in SIC 32 (Stone, Clay, Glass and Concrete Products) contained a large volume of inert solids which were not necessarily hazardous (State of Maryland, 1977 and 1977a).

The Massachusetts Division of Water Pollution Control sponsored a survey of hazardous waste generation and disposal in 1975. The survey contacted 446 of 4,868 (9.2 percent) companies considered potential generators, representing 45.4 percent of the industrial employment in the state. It concentrated on SIC codes 22 and 26-39, obtaining data on all but SIC 32. Data were determined at the three-digit and four-digit SIC code levels, extrapolated to the whole state based on the percentage of employees contacted, and reported at the two-digit SIC code level. The survey report also presented the raw data, which were used for the development of the nationwide generation factors. The working definition of hazardous wastes was "waste substances which because of their chemical, flammable, explosive, or other characteristics constitute or may reasonably be expected to constitute a danger to the public health, safety, or welfare to the environment." Additional detailed definitions divided hazardous wastes into five categories: waste oils; solvents and chlorinated oils; toxic metals, etchants, pickling and plating wastes; explosives, reactive metals and compounds; and hazardous, chemical, biological and radioactive wastes (Fennelly et al., 1976).

Minnesota's hazardous waste survey was performed jointly by the Minnesota Pollution Control Agency and Battelle, Pacific Northwest Laboratories (Battelle, Pacific Northwest Laboratories, 1977). Information from earlier surveys (e.g., Barr Engineering Co., 1973) was included, but the primary data sources for the report were a written survey conducted by mail with the co-operation of the Minnesota Association of Commerce and Industry and a field survey of major industries. Various criteria and definitions were considered for delineating hazardous waste. The existing state definition was "any refuse or discarded materials in solid, semi-solid, liquid, or gaseous form which cannot be handled by routine waste management techniques because they pose a substantial present or potential hazard to human health or other living organisms because of their chemical, biological, or physical properties. Categories of hazardous materials include, but are not limited to: explosives, flammables, oxidizers, poisons, irritants, and corrosives." In addition, the survey used information presented in the literature and compared potentially hazardous wastes with a "waste category list" and with EPA Drinking Water Standards (eliminating wastes which meet the standards even though they may contain low levels of pollutants such as chromium, lead, and other metals). The survey was conducted at the two-digit, three-digit, and four-digit SIC code levels and covered 822 of 3,981 (21 percent) industries in SIC codes 20-39, representing 22 percent of the total industrial employment in the state. In individual SIC codes, the coverage ranged from 6 to 53 percent of the employees. The wastes volumes were extrapolated based on the number of employees in the most detailed SIC code level, and adjusted for waste generation of a few large companies considered unrepresentative of the other companies in their SIC codes (Battelle, Pacific Northwest Laboratories, 1977).

The Mississippi State Board of Health (State of Mississippi, 1975) inventoried all wastes generated in the state which were not under the regulatory authority of the Mississippi Air and Water Pollution Control Commission; i.e., the survey did not collect data on discharges to air or surface waters, but concentrated on "solids, liquids, and sludges destined for land disposal, including solids and sludges in settling ponds, evaporation ponds, and biological lagoons." A category of "special wastes" was created for those wastes "which were deemed hazardous, as well as those which may not be imminently hazardous but do require extraordinary handling and disposal techniques; e.g., waste oil." Questionnaire forms were sent to each of the 2,146 manufacturers listed in the Mississippi Manufacture's Survey. The mailing achieved a response of approximately 38 percent, with about 15 percent of these (about 120 companies) considered applicable for use as raw data. Subsequent contacts by telephone and plant visits obtained data on about 360 additional companies. The survey estimated that the "industries which were contacted... constitute more than 90 percent of those producing such (special) wastes, with the exception of miscellaneous producers of paints, solvents, and waste oil." The report listed the volume of wastes and number of employees represented by the contacted industries in SIC codes 24, 25, 28-30, and 32-39. The establishments which were contacted employed 63,900 people. The 1975 Mississippi employment in those SIC groups was 120,200 (U.S. Department of Commerce, 1977).

Raw data on waste streams from individual establishments in Texas were obtained from state files maintained by the Solid Waste Branch of the Texas Department of Water Resources. The department maintains a file of each establishment in the state listing the individual waste streams and classifying the wastes using the following definitions:

Class I wastes consist of "all materials not Classes II or III, normally including all industrial solid wastes in liquid form and all hazardous wastes." Class II wastes consist of "organic and inorganic industrial solid waste that is readily decomposable in nature and contains no hazardous waste materials." Class III wastes are "essentially inert and insoluble industrial solid wastes, usually including rock, brick, glass, dirt, certain plastics and rubber, etc., that are not readily decomposable." Industrial hazardous waste "means any waste or mixture which, in the judgment of the Executive Director, is toxic, corrosive, flammable, a strong sensitizer or irritant, generates sudden pressure by decomposition, heat, or other means and would therefore be likely to cause substantial personal injury, serious illness, or harm to human and other living organisms (State of Texas, 1975)." It was estimated that the waste streams on file account for 80 percent of the hazardous wastes generated in the state (Personal communication, J. Carmichael, Texas Division of Solid Waste Management, 1977).

The Solid Waste/Resource Recovery Division of the Washington Department of Ecology conducted a hazardous waste survey in 1973 and 1974 (State of Washington, 1974). They surveyed 450 firms at the three-digit and four-digit SIC code levels, compiling information on total waste generation, recoverable waste generation, the amount actually recovered, and the amount of waste which was considered potentially hazardous. Their working definition of potentially hazardous waste was "any waste which requires special management provision in waste handling (process, storage, collection, hauling, and disposal) because of its acute and/or chronic effects on the public health and welfare, the individuals who handle it, or on the environment." The survey covered industries in SIC codes 20, 24, 26-29, and 32-35, with only partial coverage in SIC codes 26, 27, 32, 34, and 35.

EPA's Region X consists of the states of Alaska, Washington, Oregon, and Idaho. A hazardous waste survey was performed in the region in 1975 by Battelle, Pacific Northwest Laboratory (Stradley et al., 1975). Approximately 2,500 individual operations were evaluated as potential hazardous waste sources. The study identified 231 industrial sources in 11 SIC codes. In order to protect confidentiality, the report combined several sources in SIC codes 22, 33, 34, 36, and 37. Separate data were presented for groups of companies in SIC codes 2491, 271, 28, 2911, 3111, 333, 334, 335, 3471, 3479, and 3691. Although no employment data were provided and no extrapolation was performed, the report implies nearly complete coverage of wastes generated in the region.

Data from Rhode Island, Oregon, California, Ohio, and Nebraska were also examined for inclusion, but did not meet the desired criteria.

H.3 Development of Generation Factors

As previously discussed, generation factors were developed based on the assumption that the ratio of the amount of hazardous waste generated by an industry to the number of employees in that industry is approximately constant among all establishments within each industry grouping at the two-digit SIC level. Factors were derived for each two-digit SIC group in the manufacturing division (SIC codes 20-39), with the exception of SIC 21 -- Tobacco Manufacturers -- due to a nearly complete lack of data for this highly regionalized industry. The generation factors were calculated using the expression:

$$F_s = \frac{\sum_{i=1}^{N} W_{i,s}}{\sum_{i=1}^{N} E_{i,s}}$$

Where F_s is the generation factor in metric tons per employee per year for the 2-digit SIC code; $W_{i,s}$ is the amount of hazardous waste generated in SIC code s, reported for state i; $E_{i,s}$ is the number of employees associated with $W_{i,s}$; and N is the total number of states reporting data for SIC codes. Where possible, raw data were used rather than extrapolated data presented in the state surveys. Table H-1 lists the sources used, the data form (reported or extrapolated), and the SIC codes for which they presented usable data. In most cases, the generation factors were calculated based on employment data provided in the survey reports gathered at the same time as the waste data. However, in other cases, notably Illinois, Texas, and Region X,

TABLE H-1

DATA SOURCES FOR GENERATION FACTORS

State/ Region	Data Form*	SIC Codes Covered	Comments	References
Illinois	EX	20,22,25,28-39	Used list of special waste disposal permits; Extrapolated from 80 to 100 percent.	Personal communication, Miller, Illinois EPA, 1977
Kansas	RP	20,28-30,33-37	---	State of Kansas, 1977
Maryland	RP	20,22-39	Used reported waste minus cleaning wastewater; SIC 32 also excludes inorganic solids; SIC 20 includes only acid, caustic, oil, and solvent wastes.	State of Maryland, 1977 and 1977a
Massachusetts	RP	22,27-31,33-39	---	Fennelly, et al., 1976
Minnesota	EX	20,24-39	Extrapolated by employees in report; reported high and low values; median used.	Battelle, Pacific Northwest Labs, 1977
Mississippi	RP	24,25,28-30, 32-39	---	State of Mississippi, 1975
Texas	EX	20,22,24,26-30, 32-38	Used Class I wastes; extrapolated from 80 to 100 percent.	Personal communication, Carmichael, Texas DSWM, 1977
Washington	EX	20,24,26-30, 32-35	Extrapolated by employees in report; replaced by Region X data where available.	State of Washington, 1974
Region X	RP	28,29,31	Did not use for SIC codes which were covered by only one 3 or 4 digit group, or which were combined across 2 digit groups.	Stradley, et al., 1975

*EX - extrapolated to entire state; RP - as reported (raw data).

the factors were calculated using 1975 employment data from the U.S. Department of Commerce (1977).

Table H-2 presents the derived generation factors, the number of states and employment upon which the factors were based, and makes a comparison to the total U.S. employment in each SIC code. The number of states providing data ranged from one (SIC 23) to eight, and averaged six. The percentage of the U.S. employment used in developing the factors ranged from one (SIC 23) to 38 (SIC 29). In all, 14 percent of the industrial employment of the United States are represented in the factors.

H.4 Limitations of Generation Factors

Although the generation factors were derived using 14 percent of the U.S. industrial employment, there are several considerations which must be emphasized when using them to estimate total national waste generation. These are the comparability of the data sources; possible biases in the coverage of industries; inaccuracies introduced through misleading or misinterpreted company responses; inaccuracies introduced by the use of two-digit SIC codes rather than more specific groups at the three- or four-digit levels; and potential errors introduced by the assumption that waste generation per employee is constant throughout specific industries, independent of geographic region and establishment size.

H.4.1 Comparability of Data Sources. The definitions and criteria for hazardous waste included in the various data sources were

TABLE H-2

GENERATION FACTORS FOR THE CALCULATION OF ESTIMATED QUANTITIES OF HAZARDOUS WASTE GENERATED BY MANUFACTURING INDUSTRIES (BASED ON EMPLOYMENT)

		Contributing data			
SIC Code	Calculated generation factor*	Number of states	Employment (thousands)	Total 1975 U.S. employment (thousands)	Percent of U.S. employment represented
20	0.19	6	279	1,528	18
22	0.17	4	16	870	2
23	0.11	1 (Md)	6	1,221	1
24	0.13	5	81	600	13
25	0.59	5	30	408	7
26	4.86	4	55	581	9
27	0.12	5	101	1,079	9
28	33.72	8	168	849	20
29	6.29	8	57	151	38
30	0.38	7	98	593	17
31	2.49	5	14	266	5
32	2.34	6	89	593	15
33	3.49	8	189	1,098	17
34	1.27	8	250	1,398	21
35	2.35	8	445	1,979	22
36	0.13	7	349	1,533	23
37	0.59	7	179	1,599	11
38	0.13	6	85	1,915	4
39	0.64	5	54	422	13
Totals			2,591	18,684	14 (percent of national total)

*Metric tons/employee/year

not entirely consistent. As discussed in the individual state descriptions, the wastes included in the surveys varied from industrial wastes generated by 26 percent of the manufacturing establishments in Maryland to wastes currently permitted for disposal in hazardous waste facilities in Illinois. Additionally, many of the surveys made no clear distinction between wet or dry weights. Although attempts were made to standardize the data, discrepancies remained which affect the computed generation factors.

Additional discrepancies arise due to variations in the industries covered and waste exclusions used by the different surveys. For example, the Washington survey did not include any wastes which are recycled, and the Illinois data did not include wastes leaving the state. Also, the Region X study recognized only 231 generators in four states, and the Kansas survey excluded over 50 of the three-digit level industry groups within SIC codes 20-39. Some of these exclusions were due to the absence of particular industry types in various states, but others were a matter of judgement by survey personnel due to time and budget constraints. Typical criteria for exclusion were the small size of an industry, lack of cooperation from individual companies, or lack of indications in previously published studies that a particular industry group generates hazardous wastes. It is therefore possible that some industry groups which do generate hazardous wastes were omitted by the surveys. The magnitude of such omissions is difficult to estimate. However, this effect would probably be somewhat offset by an over-estimation of waste generation occurring when the factors are calculated at the two-digit level using data from only the few three-digit and four-digit industry groups which are considered to be major generators. Such an over-estimation occurs when the generation factors are based on information from large generators without counting the employees of industries which produce little or no hazardous wastes.

Another potential error source in the generation factors was the method of scaling data up to state levels in cases where employment data corresponding to the raw generation data were not available. In two cases (Minnesota and Washington), the data were scaled up in the original survey report. However, in the cases of Illinois and Texas, the data were scaled up linearly, based on estimates by state personnel that the raw data accounted for 80 percent of the hazardous wastes generated in each state. For lack of a better algorithm, each SIC code was scaled equally. This procedure may have inflated the factors for industry groups predominantly composed of larger hazardous waste generators and underestimated the factors for industry groups predominantly composed of small generators or non-generators.

The time periods during which the different surveys were undertaken also varies, ranging from 1973 to 1977. For the purpose of estimation of total U.S. waste generation, the factors were assumed to apply to 1975. (Five of the nine studies were conducted in time periods that included 1975.) Although it is conceivable that the other studies could have been normalized to 1975, it was felt that any resulting increase in accuracy would be negligible.

H.4.2 Possible Biases in Industry Coverage. Much of the data gathering activities of the state surveys concentrated on larger companies in industry groups suspected to be major generators. In general, small companies in industry groups not normally considered to be hazardous waste generators were poorly represented, if represented at all. Larger companies are often diversified, with a larger proportion of their employees involved in activities which do not produce hazardous wastes. Further, with their generally greater resources and larger production, large companies may be more likely to take advantage of economies of scale and employ more extensive recycling measures (for both water and raw materials) than smaller companies, consequently reducing the relative volume of hazardous wastes that they generate. Each of these factors would tend to decrease the computed generation factor for a particular industry group.

H.4.3 Possible Inaccuracies Due to Company Responses. Most of the surveys found that the majority of industries contacted were generally cooperative and interested in finding acceptable solutions to hazardous waste problems. However, some error was undoubtedly introduced due to the necessary reliance on company-supplied data. Companies are frequently reluctant to supply data which could conceivably be used against them by regulatory agencies at some future time. Others are concerned about protecting proprietary information such as process characteristics, production volumes, and employment data. In addition, some establishments, especially the smaller ones, do not presently segregate their hazardous wastes and may not even have a good idea of the quantities they generate. Many of those companies do not wish to devote the necessary time and manpower to determining such data from the design characteristics of their processes or by analyzing their effluents.

It is therefore conceivable that some of the data reported was incomplete or otherwise unrepresentative of the actual waste generation of the particular company. In fact, it was noted in several surveys that there was a very wide scatter in hazardous waste generation from similar companies in the same industrial area. This may have been due to misinterpretation of the survey questions, differences in reporting (e.g., reporting only the hazardous components in a large waste stream versus reporting the whole stream), or deliberate omissions. In some cases, attempts were made by the survey group to identify obvious discrepancies, but in others, and in ambiguous cases, much of these data were included in the totals.

H.4.4 Aggregation at the Two-Digit SIC Level. Estimation of the generation factors at the two-digit level was necessitated by the lack of sufficient data to estimate the factors at any more detailed level. However, this approach is subject to several inherent sources of error. Two-digit SIC codes include numerous industry types which, though all related in a general way, may possess markedly different process and waste generation characteristics. SIC 31 -- leather and leather products -- is an outstanding example. Table H-3 lists the four-digit industry groups contained in SIC 31. Of these, only SIC 3111 (leather tanning and finishing) would be expected to generate large quantities of hazardous wastes. Many of the state surveys omitted the other groups in SIC 31 and reported only wastes produced and employment in SIC 3111. This procedure would tend to increase the generation factors compared to using the total employment for all groups in SIC 31. However, the leather tanning industry is not reported separately in the U.S. census publications, and therefore could not be broken out for purposes of calculating the nationwide generating factors. An additional, related problem is that many leather tanning companies are small "backyard" type operations which could easily escape recognition and subsequent inclusion in the data base.

Although SIC 31 is perhaps the most prominent example of the type of errors produced by aggregation at the two-digit SIC code level, such errors could also occur throughout the manufacturing SIC codes. Such phenomena might help explain the wide variation observed in statewide generation factors for SIC 28 (Chemicals and Allied Products). The factors calculated for Texas and Mississippi were 65 and 129 metric tons per employee, respectively, while those calculated for the other states ranged from 0.9 to 35.3 metric tons per employee. It is conceivable that these differences might be partially explained by

TABLE H-3

STANDARD INDUSTRIAL CLASSIFICATION
MAJOR GROUP 31 - LEATHER AND LEATHER PRODUCTS*

SIC	Establishment
3111	Leather tanning and finishing
3131	Boot and shoe cut stock and findings
3142	House slippers
3143	Men's footwear, except athletic
3144	Women's footwear, except athletic
3149	Footwear, except rubber, not elsewhere classified
3151	Leather gloves and mittens
3161	Luggage
3171	Women's handbags and purses
3172	Personal leather goods, except women's handbags and purses
3199	Leather goods, not elsewhere classified

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* U.S. Office of Management and Budget, 1972.

a relative concentration of chemical industry subgroups which produce large volumes of hazardous wastes in the south-central states.

H.4.5 Waste Generation per Employee. The assumption that waste generation per employee is constant may not be strictly correct. Two potential sources of error are that different sized establishments may generate relatively different quantities of hazardous wastes per employee and that regional influences may also result in variations in waste generation per employee within similar industries. Regional influences, such as local economics, quantity and quality of raw materials available, transportation costs and limitations, and pollution laws all affect the type of production processes chosen by a company. Regionalization of process types would also produce a regionalization of waste generation characteristics, which is neglected in the nationwide generation factors, again due to lack of appropriate data.

H.5 Application of Generation Factors

Due to the limitations discussed above, the generation factors developed in this appendix are most useful when applied to the approximation of hazardous waste generation over large areas, thereby taking maximum advantage of the averaging effects of large samples.

Therefore, the generation factors presented in Table H-2 were used to estimate the annual hazardous waste production in each EPA Region in 1975, using employment data from the U.S. Department of Commerce (1977). These estimates are presented in Table H-4.

TABLE H-4

SUMMARY OF HAZARDOUS WASTE GENERATED BY EPA REGION -- 1975*
(1000 metric tons per year)

Standard Industrial Classification	ENVIRONMENTAL PROTECTION AGENCY REGION										Total	Percent of Total	Ranking
	I	II	III	IV	V	VI	VII	VIII	IX	X			
20 Food and kindred products	10	25	30	45	70	30	25	9.0	35	15	290	0.5	10
22 Textile mill products	10	10	15	100	3.5	2.5	0.5	<0.5	2.0	0.5	140	0.5	15
23 Apparel and other textile products	7.0	30	20	40	10	10	4.0	1.0	10	1.0	130	0.5	16
24 Lumber and wood products	4.0	3.0	7.0	20	10	8.0	2.5	2.0	8.5	20	80	<0.5	18
25 Furniture and fixtures	9.5	20	25	75	50	15	7.5	1.5	25	2.5	240	0.5	12
26 Paper and allied products	290	350	290	530	760	200	120	10	180	130	2,870	6	4
27 Printing and publishing	9.0	20	15	15	30	8.0	8.5	3.0	10	2.5	130	0.5	17
28 Chemicals and allied products	1,060	5,290	3,600	5,920	5,770	3,270	1,230	170	1,880	460	28,700	60	1
29 Petroleum and coal products	25	95	85	50	160	330	45	30	110	20	950	2	7
30 Rubber and misc. plastics products	20	25	20	35	75	15	10	2.0	20	2.0	220	0.5	13
31 Leather and leather products	130	95	70	90	120	35	85	8.5	10	1.5	640	1.5	9
32 Stone, clay and glass products	65	160	210	230	350	120	60	35	130	30	1,390	3	6
33 Primary metal industries	140	290	870	350	1,520	190	110	75	200	95	3,830	8	3
34 Fabricated metal products	140	170	180	180	700	150	85	20	160	25	1,800	4	5
35 Machinery, except electrical	370	450	400	420	1,830	350	290	80	400	60	4,650	10	2
36 Electric and electronic equipment	20	30	20	25	55	10	9.0	1.5	25	1.0	200	0.5	14
37 Transportation equipment	65	55	60	80	350	60	60	10	150	45	940	2	8
38 Instruments and related products	10	15	5.5	4.0	15	2.0	2.0	1.5	8.0	1.5	65	<0.5	19
39 Misc. manufacturing industries	40	55	20	35	60	15	10	6.0	20	5.0	270	0.5	11
TOTAL[†]	2,440	7,190	5,940	8,240	11,900	4,810	2,170	470	3,380	920	47,500		
Percent of Total	5	15	13	17	25	10	5	1	7	2			

*These numbers are estimated based upon the generation factors as derived in Appendix H.

[†] Totals may not balance due to rounding of numbers.

Total national hazardous waste generation by manufacturing industries in 1975 is estimated to be 47.5 million metric tons. Based upon the previously referenced Industry Studies (1975-1978), hazardous waste generation from manufacturing industries could increase by an average rate of approximately 3.6 percent a year through 1984. This increase is primarily attributable to additional waste loads from increased wastewater treatment. Assuming this growth rate holds for the aggregated hazardous waste generation by manufacturing industries, the estimated 47.5 million metric tons of manufacturing hazardous waste generation could increase to 56.7 million metric tons in 1980 and 65.3 million metric tons in 1984.

APPENDIX I

DOCUMENTATION FOR PHASING CALCULATIONS

The number of firms and amounts of hazardous wastes that are subject to regulation can be controlled to a large degree through the use of a generation limit. With such a limit, any firm generating less than a specified amount of hazardous wastes per year, i.e., the generation limit, would be excluded from compliance with the provisions of the Subtitle C regulations. This appendix describes the methodology used in this statement for estimating the number of firms and the amounts of hazardous wastes that would be regulated for any generation limit under the proposed and alternative regulations.

A FORTRAN computer program was written to compute the amounts of waste and number of firms in each two-digit manufacturing SIC code in SIC groups 20, 22 - 39 and in each EPA region which would be subject to regulation in any given year at any generation limit. The program is based on the hazardous waste generation factors discussed in Appendix H and on employment and firm size distribution data from the U.S. Department of Commerce (1976 and 1977). The firm size distribution data are contained in Appendix K. As discussed in Appendix H, a uniform growth factor of 3.6 percent per year is applied to all SIC codes in all regions.

I.1 Methodology

The program first computes the number of employees in the smallest firm subject to regulation in each SIC code, a variable called ESFM. The equation is:

$$\mathrm{ESFM} = \frac{\mathrm{EXCL}}{\mathrm{FACT(i)} * 1.036^{(N-75)}}$$

where EXCL is the generation limit (metric tons per year); FACT(i) is the generation factor for SIC code i, and N is the last two digits of the year of interest (e.g., 85), 1975 is used as the base year.

The U.S. Department of Commerce firm size distribution data consist of the numbers of firms in each of ten firm size classes. The data were developed in 1972, and are presented in Appendix K for each state and SIC code. The state data were aggregated into EPA regions and tabulated in a data file as the parameter NSIZE, a 19 x 10 x 10 matrix. ESFM determines the cut-off size class. All firms in smaller size classes would be excluded from regulation, while all firms in larger classes would be subject to the regulations. The firms in the cut-off class would be split, with some subject to regulation and the others excluded.

The program sums the firms in the smaller size classes as the variable FRMEX and computes the number of employees represented by those firms by multiplying the number of firms in each class (NSIZE) by the average number of employees in that class (AVGK). For example, since the second size class is 5 to 9 employees, the total number of employees represented by the firms in that class is estimated as NSIZE (i,j,2)*7, where i and j represent the SIC code and region of interest, respectively. Both the number of firms and employees in the cut-off size class which would be excluded are determined by linear interpolation, based on the assumption that the firms in each class are distributed uniformly by size. Since the largest firm size class reported by the Department of Commerce contained all firms employing more than 2,500, an arbitrary upper bound of 3,500 and an average of 3,000 employees per firm were assumed for that class.

After determining the total number of firms that would be excluded, and summing their total 1972 employment (EMP), the total hazardous waste excluded from regulation is computed using the generation factors developed in Appendix H. This total is normalized to a base year of 1975 using the ratio of 1975 to 1972 employment in each SIC code in each region. The specific equation is:

$$\mathrm{HAZEXC}\ (i,j) = \mathrm{EMP} * \mathrm{FACT}(i) * 1.036^{(N-75)} * \frac{\mathrm{E75B}(i,j)}{\mathrm{E72B}(i,j)}$$

where HAZEXC(i,j) is the total hazardous waste generated in region j by firms in SIC code i that is exempt from the regulations (metric tons per year); EMP, FACT (i), and N are as defined earlier; E75B(i,j) is the reported 1975 employment of SIC code i in region j; and E72B(i,j) is the reported 1972 employment in the same SIC code and region. The effects of this adjustment are explained in a later section of this Appendix.

The amount of wastes subject to regulation (HAZREG(i,j)), is determined by the equation:

$$\mathrm{HAZREG}(i,j) = \mathrm{E75B}(i,j) * \mathrm{FACT}(i) * (1.036)^{(N-75)} - \mathrm{HAZEXC}(i,j).$$

HAZREG, HAZEXC, and FRMREG (Number of firms subject to regulation) are summed by both SIC code and region. Additionally, the program determines the percentage of total hazardous wastes and firms subject to regulation for each SIC code in each region.

I.2 Operation

The basic program iteration computes the distribution of wastes and firms subject to regulation for any given year and generation limit. The program contains several control options. These operate in a conversational mode and include the ability to print the regional and industry outputs off-line; to compute targets (total waste regulated per year) for a 5-year phase-in of the regulations (see Chapter 4); and to change the year and generation limit for recomputation of the amounts of waste regulated. Additionally, a parameter check option computes the ratios of 1975 to 1972 employment in each SIC code and region as well as the ratio of the 1972 employment determined by interpolation of the firm size distribution to the total employment reported in 1972 in each SIC code and region. A cycling option automatically increments the generation limit and reiterates the program to determine the amount of waste and numbers of firms subject to regulation for each of 17 generation limits from 25 to 1,000 metric tons per year.

I.3 Output

Table I-1 is a sample printout showing the amounts of hazardous wastes which would be regulated in 1984 with a generation limit of 1.2 metric tons per year (100 kg per month). This generation limit

TABLE I-1

APPROXIMATE DISTRIBUTION OF HAZARDOUS MANUFACTURING WASTES SUBJECT TO
REGULATION IN 1984 - GENERATION LIMIT 100 Kg/Mo
(ALL WASTES IN 1000's OF METRIC TONS PER YEAR)

SIC CODE		REGION										
		1	2	3	4	5	6	7	8	9	10	TOT
20	HW REG	14.37	35.97	42.13	60.92	92.16	38.28	34.50	12.50	45.30	17.55	393.68
	HW EXC	0.33	0.52	0.53	0.81	1.17	0.58	0.39	0.25	0.55	0.24	5.37
	FM REG	1013.	2054.	2032.	2754.	4262.	1948.	1493.	685.	2151.	878.	19272.
	% FM R	62.17	68.57	69.57	68.03	68.40	67.63	69.74	65.44	70.79	70.21	68.38
22	HW REG	14.10	14.75	21.17	134.55	4.83	3.28	0.79	0.21	2.73	0.83	197.23
	HW EXC	0.06	0.14	0.05	0.19	0.03	0.01	0.01	0.00	0.03	0.01	0.54
	FM REG	675.	1554.	679.	2457.	213.	97.	32.	14.	211.	25.	5957.
	% FM R	81.57	79.88	85.82	86.22	73.31	78.53	72.94	71.30	77.46	62.16	82.69
23	HW REG	9.23	37.30	27.45	54.64	13.27	15.66	5.30	1.34	13.20	1.48	178.87
	HW EXC	0.10	0.93	0.14	0.22	0.22	0.13	0.04	0.04	0.39	0.05	2.26
	FM REG	940.	6923.	2196.	2444.	1005.	668.	394.	103.	1778.	124.	16575.
	% FM R	73.27	65.71	81.52	76.66	58.78	65.39	72.61	52.57	59.28	47.87	67.85
24	HW REG	4.26	3.38	7.81	22.75	13.74	10.70	3.22	2.64	10.15	21.31	99.97
	HW EXC	0.49	0.25	0.82	2.56	0.93	0.74	0.21	0.18	0.41	0.71	7.30
	FM REG	713.	702.	1206.	3312.	1826.	1225.	403.	347.	1251.	2121.	13107.
	% FM R	36.03	47.84	34.44	30.81	41.22	36.86	40.78	40.95	50.48	50.97	38.63
25	HW REG	13.30	25.45	35.28	104.85	71.11	22.86	10.54	2.43	35.34	3.65	324.80
	HW EXC	0.01	0.02	0.01	0.03	0.02	0.01	0.00	0.00	0.03	0.00	0.14
	FM REG	453.	1300.	676.	1739.	1408.	638.	307.	127.	1366.	197.	8212.
	% FM R	88.90	88.65	90.49	89.53	89.71	86.95	89.14	87.08	88.04	85.43	88.85
26	HW REG	402.89	484.41	402.89	732.29	1044.31	272.60	158.35	16.70	247.21	184.41	3946.08
	HW EXC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	FM REG	600.	1242.	625.	718.	1510.	343.	237.	57.	533.	145.	6010.
	% FM R	99.41	99.27	99.37	99.46	99.45	99.43	99.49	99.29	99.21	99.51	99.38
27	HW REG	12.10	30.14	20.21	16.70	40.54	10.18	11.08	3.53	15.49	3.24	163.21
	HW EXC	0.54	1.53	0.84	1.34	1.82	0.94	0.72	0.35	1.27	0.30	9.65
	FM REG	1222.	3282.	1639.	1709.	3896.	1151.	994.	367.	1762.	384.	16406.
	% FM R	45.11	41.93	42.96	34.18	42.34	32.84	36.29	32.35	34.88	34.25	38.97
28	HW REG	509.39	2546.94	1730.94	2850.30	2774.05	1571.96	592.12	82.73	903.59	222.25	13784.25
	HW EXC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	FM REG	651.	2001.	1025.	1607.	2531.	1134.	628.	174.	1367.	242.	11361.
	% FM R	99.32	99.41	99.45	99.45	99.40	99.33	99.41	99.24	99.35	99.33	99.39
29	HW REG	34.59	128.85	118.47	70.04	223.97	453.12	61.40	41.51	149.60	24.21	1305.76
	HW EXC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FM REG	106.	250.	236.	240.	445.	294.	90.	62.	254.	82.	2059.
	% FM R	98.90	98.97	99.07	98.94	99.01	99.17	99.28	99.01	98.76	99.25	99.01

TABLE I-1 (CONCLUDED)

30 HW REG	31.07	32.00	27.83	45.47	104.07	17.64	16.81	3.81	26.71	2.50	307.91
HW EXC	0.02	0.03	0.01	0.03	0.05	0.02	0.01	0.00	0.04	0.01	0.21
FM REG	737.	1334.	567.	841.	2247.	449.	310.	107.	1082.	148.	7823.
% FM R	86.16	85.34	87.57	83.62	86.44	79.80	85.17	79.16	80.59	76.15	84.38
31 HW REG	177.32	133.85	94.48	123.58	160.89	45.87	119.47	11.64	17.12	2.40	886.60
HW EXC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
FM REG	643.	944.	253.	278.	369.	185.	163.	31.	224.	43.	3132.
% FM R	98.26	97.83	98.84	97.72	97.86	97.14	98.42	96.44	96.41	95.72	97.83
32 HW REG	88.46	221.65	283.73	313.65	486.40	166.95	84.92	42.46	175.32	42.14	1905.69
HW EXC	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.07
FM REG	799.	1520.	1581.	2608.	3703.	1568.	1035.	558.	1647.	527.	15546.
% FM R	97.16	97.06	97.62	97.21	97.10	96.76	96.56	96.17	96.87	96.28	97.01
33 HW REG	197.68	392.00	1189.31	478.84	2091.93	259.57	147.78	106.52	273.01	130.99	5268.20
HW EXC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
FM REG	586.	803.	729.	598.	2360.	366.	252.	104.	765.	155.	6716.
% FM R	98.75	98.72	99.03	98.88	98.98	98.65	99.09	98.17	98.57	98.53	98.84
34 HW REG	198.67	231.66	245.47	251.05	961.27	199.37	113.83	27.23	216.30	37.01	2481.87
HW EXC	0.02	0.03	0.02	0.02	0.07	0.02	0.01	0.00	0.03	0.01	0.22
FM REG	2508.	3971.	2373.	2745.	9186.	2048.	1095.	422.	3612.	643.	28604.
% FM R	94.85	94.91	95.50	94.75	95.09	94.04	95.19	93.68	94.45	93.51	94.83
35 HW REG	511.09	613.82	554.70	573.43	2516.69	483.29	404.80	112.75	547.57	80.44	6398.57
HW EXC	0.02	0.03	0.02	0.02	0.07	0.03	0.01	0.01	0.04	0.01	0.26
FM REG	3215.	4716.	2928.	3437.	13170.	2946.	1848.	625.	5414.	941.	39240.
% FM R	96.28	96.11	96.35	95.95	96.65	95.74	96.22	95.64	95.59	95.50	96.19
36 HW REG	26.31	40.16	29.00	31.94	77.39	15.47	12.16	1.97	36.54	1.40	272.34
HW EXC	0.14	0.31	0.11	0.14	0.28	0.11	0.05	0.03	0.39	0.05	1.61
FM REG	811.	1535.	695.	687.	1874.	412.	251.	92.	1427.	109.	7894.
% FM R	69.05	62.90	68.84	64.72	69.29	57.61	69.02	52.11	59.72	47.20	64.34
37 HW REG	89.78	75.50	82.48	113.05	478.62	81.90	85.65	14.27	206.48	60.82	1288.56
HW EXC	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.00	0.03	0.01	0.16
FM REG	408.	582.	482.	1148.	1830.	843.	423.	173.	1437.	373.	7698.
% FM R	87.33	87.01	88.03	86.82	89.96	86.20	88.00	84.48	86.93	83.24	87.44
38 HW REG	13.91	22.33	7.36	5.63	18.73	2.91	2.50	2.05	10.79	2.26	88.45
HW EXC	0.11	0.21	0.10	0.09	0.22	0.08	0.06	0.04	0.26	0.03	1.18
FM REG	386.	707.	309.	208.	702.	168.	108.	58.	594.	64.	3305.
% FM R	61.59	57.32	57.30	50.07	57.63	48.37	52.19	44.79	52.18	48.25	55.18
39 HW REG	58.74	74.02	30.07	49.67	79.48	20.21	14.68	8.26	28.21	7.02	370.36
HW EXC	0.03	0.06	0.02	0.05	0.05	0.03	0.01	0.01	0.04	0.02	0.33
FM REG	1534.	3675.	824.	1249.	2251.	782.	499.	265.	1545.	330.	12953.
% FM R	86.35	87.35	85.26	82.65	85.67	82.45	85.40	82.32	83.81	82.61	85.30
TOT HW REG	2407.26	5144.14	4951.39	6033.32	11253.45	3691.85	1879.90	494.55	2960.64	845.88	39662.36
HW EXC	1.88	4.09	2.66	5.53	4.99	2.73	1.54	0.93	3.52	1.46	29.32
FM REG	17999.	39094.	21056.	30779.	54788.	17266.	10562.	4372.	28420.	7534.	231869.
% FM R	77.39	74.75	74.63	67.31	79.41	70.88	73.75	67.49	74.54	66.28	74.64

could subject over 99.9 percent of the wastes and approximately 74 percent of the manufacturing firms to regulation in 1984.

Figure I-1 is a graph of the output of the cycling option for 1984. It illustrates the variation of total wastes generated versus firm size. The lower curve shows the percentage of all manufacturing establishments which generate more hazardous waste than the corresponding generation limit on the horizontal axis; and the upper curve shows the percentage of total hazardous wastes generated by those firms. For example, although only about three percent of all manufacturing establishments generate more than 1,000 metric tons per year, they account for nearly 80 percent of the total hazardous wastes. Similarly, the 14 percent of all manufacturing establishments which generate more than 100 metric tons per year account for 95 percent of the total hazardous wastes.

I.4 Limitations and Applicability of Methodology

As with all such automated data manipulation schemes, this program is based on several assumptions and generalizations which could affect the accuracy of the results. In analyzing the waste distribution by two-digit SIC codes at the individual regional level, the applicability of the generation factor approach, data accuracy, and all of the other limitations discussed in Appendix H become constraints on the resolution of the program. The approach used for this program necessitates a rigorous application of the generation factors to individual manufacturing establishments in each size

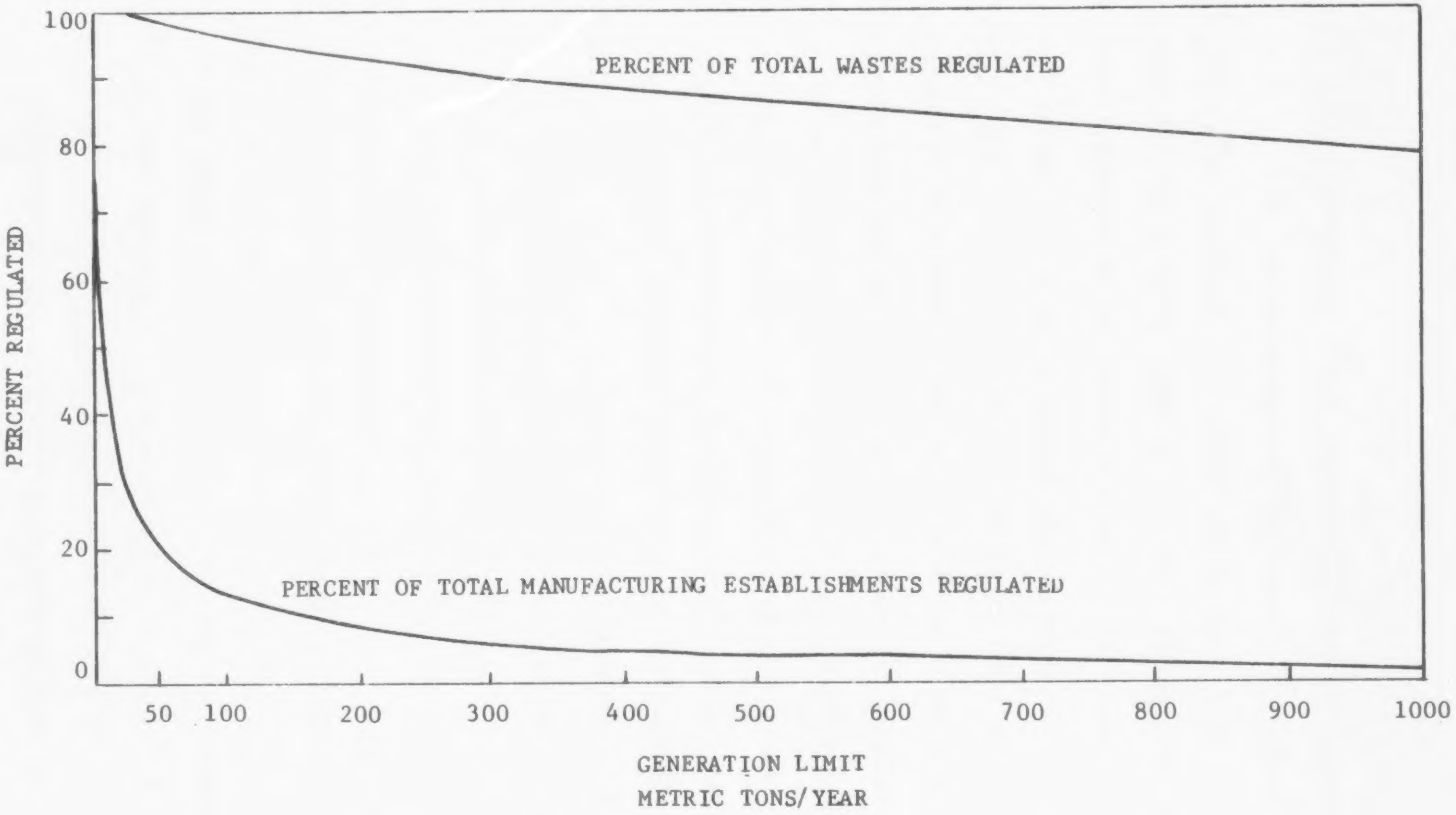

FIGURE I-1
CUMULATIVE HAZARDOUS WASTE GENERATION
1984

class, thereby negating the averaging effects which occur when treating all size classes in one group. Also implicit in this approach is the assumption that all manufacturing establishments generate hazardous wastes. While this is true to some degree (e.g., waste lubricating oils and cleaning agents), the generation factor approach would tend to exagerate the amount of hazardous wastes produced by some generators. The program output should therefore be interpreted only as an indication of the relative magnitude and approximate regional distribution, rather than as the actual amounts of wastes and number of generators which would be controlled in each region at each generation limit. As more and better data become available, the approach could be refined to improve the accuracy and detailed resolution of the program.

Other factors that may affect the results include the scaling of employment from 1972 to 1975; the linear interpolation of number of employees in different firm size classes; the assumption that the number and regional distribution of manufacturing establishments remained constant from 1972 to 1975; and the use of a uniform growth factor for waste generation from all SIC codes in all regions.

The effects of the first two factors can be determined using the parameter check option contained in the program. The first check computes the ratio of 1975 employment to 1972 employment in each SIC code and each region. This is the scaling factor applied to normalize the results to a base year of 1975. The ratios are shown in

Table I-2. During the period in question, total employment dropped by about four percent. The largest decreases (up to 13 percent) occurred in SIC codes 22 to 25. Employment in SIC groups 29, 35 and 38 increased by up to 11 percent. To some degree these changes were obscured by Census Bureau reporting methods designed to prevent the disclosure of individual company data.* Where possible, adjustments were made to account for this additional unreported employment.

The effects of linear interpolation of employees within the various firm size groups are shown in Table I-3. The net effect for all SIC codes is a three percent over-estimation of employment by interpolation. The largest increases occur in SIC codes 24, 32, and 39. A total of ten SIC codes were overestimated by between 10 and 14 (maximum) percent. Four SIC codes were underestimated, the most significant being SIC code 37 (27 percent), with the other three being less than ten percent below the reported total. These differences may be partly caused by Census Bureau reporting methods preventing disclosure of individual company data. However, close examination of the interpolation error compared to the firm size distribution data indicates that most of the error occurs in the larger firm size classes, which contain firms with employment ranges of a thousand or

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*In order to avoid disclosure of individual company data, employment in three-digit and four-digit SIC codes was sometimes reported as a range. In some cases, the ranges were carried to the two-digit totals. Since the largest range was 2,500 or more employees, such methods could underestimate total employment by a significant amount.

TABLE I-2

EMPLOYEE RATIOS, 1975/1972

SIC	Region										
	1	2	3	4	5	6	7	8	9	10	TOT
20	0.86	0.91	0.96	1.00	0.96	1.00	0.99	1.11	1.00	1.05	0.97
22	0.80	0.74	0.84	0.92	0.82	0.97	1.48	1.50	0.97	1.33	0.89
23	0.88	0.79	0.83	0.89	0.90	1.01	0.87	1.12	0.98	1.11	0.87
24	0.96	0.84	0.87	0.83	0.89	0.86	0.90	0.89	0.86	0.89	0.87
25	0.82	0.80	0.77	0.87	0.90	0.89	0.84	1.00	0.96	0.90	0.87
26	0.95	0.86	0.89	0.95	0.91	0.92	1.18	0.83	1.05	0.93	0.93
27	0.97	0.92	1.04	1.07	0.93	1.05	1.09	1.19	1.03	1.10	0.99
28	0.93	0.99	0.92	1.06	0.97	0.89	1.01	1.31	1.16	1.29	0.99
29	1.60	1.66	0.88	1.25	0.95	1.07	1.29	1.20	1.02	1.00	1.08
30	0.92	0.78	0.92	1.14	0.93	1.12	1.10	1.07	0.97	1.33	0.96
31	0.79	0.83	0.87	0.92	1.21	0.91	1.74	1.36	0.64	1.40	0.97
32	0.95	0.93	0.90	0.96	0.94	1.01	0.93	1.03	0.97	1.28	0.95
33	0.82	0.91	0.97	0.96	0.94	1.06	1.07	1.50	0.95	1.36	0.97
34	0.97	0.86	0.98	0.97	0.93	1.08	0.91	0.89	0.99	1.25	0.95
35	1.04	0.95	1.09	1.14	1.03	1.36	1.18	1.38	1.16	1.17	1.08
36	0.98	0.88	0.91	0.94	0.87	0.93	1.02	1.03	1.03	1.05	0.92
37	1.09	0.92	1.06	0.87	0.90	0.96	0.96	0.94	0.92	1.26	0.94
38	1.16	1.04	1.08	1.07	1.08	1.05	1.42	1.29	1.20	1.09	1.11
39	0.92	0.79	0.86	1.20	0.97	1.19	0.98	1.68	0.86	1.45	0.95

Ratio of all Totals - 0.96

TABLE I-3

RATIO OF TOTAL EMPLOYEES BY INTERPOLATION TO GIVEN TOTAL - 1972

SIC	Region										
	1	2	3	4	5	6	7	8	9	10	TOT
20	1.11	1.09	1.12	1.11	1.08	1.13	1.11	1.09	1.11	1.12	1.10
22	1.09	1.11	1.05	1.09	1.08	0.95	1.16	1.24	1.12	0.98	1.08
23	1.12	1.12	1.10	1.09	1.10	1.10	1.11	1.19	1.14	1.22	1.11
24	1.12	1.14	1.17	1.15	1.16	1.14	1.16	1.12	1.15	1.11	1.14
25	1.12	1.13	1.12	1.11	1.11	1.09	1.05	1.18	1.13	1.21	1.11
26	1.09	1.13	1.10	1.13	1.10	1.14	1.15	1.07	1.12	1.10	1.11
27	1.13	1.09	1.12	1.15	1.10	1.18	1.04	1.15	1.12	1.20	1.11
28	1.13	1.07	1.05	0.99	1.04	0.86	1.11	1.15	1.11	1.12	1.03
29	1.17	1.38	1.03	1.16	1.08	1.00	1.11	1.13	1.09	1.49	1.08
30	1.09	1.11	1.15	1.15	1.01	1.11	1.10	1.03	1.15	1.18	1.09
31	1.10	1.09	1.10	1.08	1.12	1.07	1.29	0.95	1.13	1.35	1.11
32	1.12	1.11	1.11	1.15	1.11	1.13	1.18	1.16	1.16	1.16	1.13
33	1.16	0.98	0.75	1.02	0.87	1.00	1.05	1.20	1.00	1.23	0.91
34	1.11	1.11	1.12	1.09	1.11	1.10	1.02	1.09	1.11	1.13	1.10
35	1.09	1.03	1.03	1.13	1.02	1.10	1.01	1.12	1.07	1.20	1.05
36	1.02	0.99	1.04	1.06	0.93	0.81	0.97	1.20	0.99	1.11	0.98
37	0.66	0.77	0.96	0.86	0.72	0.81	0.70	0.78	0.65	0.59	0.73
38	1.02	0.74	1.12	1.12	1.05	1.07	1.16	1.25	1.14	0.84	0.99
39	1.10	1.10	1.14	1.14	1.14	1.13	1.06	1.11	1.09	1.15	1.12

Ratio of all Totals - 1.03

more in the same class. SIC code 37 contains 161 firms in the largest size class (more than 2,500 employees). In this case, the assumed average size of 3,000 employees for this class was apparently much too small, since the interpolated employment was nearly 30 percent less than that reported. SIC codes 32 and 39 both contained less than ten firms with more than 2,500 employees. In these cases, the assumed average size of 3,000 employees was probably too large, resulting in the larger employments as determined by interpolation.

Since the program determines the amount of hazardous wastes regulated by subtracting the amount of wastes excluded (determined using interpolated employment) from the total amount generated (determined using total, rather than interpolated employment), the errors which result from interpolation probably affect the results only for large exclusions (greater than 100 metric tons per year), when the program interpolates in the large size classes or includes all employees in a SIC code. In these cases the results could underestimate the amounts of waste subject to regulation (except in SIC code 37 which would be overestimated). However, on the average, over all SIC codes this effect amounts to a net increase of only three percent, and then only in a few situations, since the program performs an automatic check and correction process to ensure that the excluded wastes never exceed the total wastes generated within a SIC code, thereby eliminating some of the interpolation error at high exclusion values.

An error which occurs as a result of assuming no changes in number of firms between 1972 and 1975 is difficult to determine. However, as shown in Table I-2, the net change in employment during this period was only four percent. Therefore, although changes in individual SIC codes and regions may have been larger, the net effect on the determination of total wastes generated was probably within the range of other error sources in the program.

The uniform growth rate is based on data from the Industry Studies (1975-1978), as discussed in Appendix H. While it is probable that growth will not occur uniformly in each SIC code in each region, the average growth over all SIC codes nationally is expected to be about 3.6 percent per year. Since the total amount of hazardous waste generation increases each year, it is likely that the amount of wastes that would be excluded from regulation at any given generation level would also increase annually. The uniform growth rate was included to demonstrate this effect for lack of more accurate data. As more and better data become available, the rates for individual SIC codes and regions could be adjusted.

These limitations serve to emphasize the point that the information provided by this program consists of estimates only. The results should be viewed only as approximations of the relative magnitudes of the waste generation in, and effects of various exclusion levels on, the major industry groups and EPA regions.

I.5 Program Listing

Table I-4 contains a complete listing of the program as run on IBM System 370-148 operating on a VM/CMS System, using a FORTRAN G compiler. The execution control statements defined input/output files 1 and 2 as the user's terminal, file 5 as a disk-loaded data file, and file 6 as the high-speed printer. All data requirements are contained in a single data file, stored on disk.

I.6 Glossary

Indexes

I - SIC code. I = 1 corresponds to SIC code 20. All other manufacturing SIC codes are represented by SIC = I + 20. I = 20 is total for all SIC codes.

J - Federal region. Corresponds directly to the 10 Federal regions. J = 11 is total for all regions.

K - Firm size class. Corresponds to the 10 Bureau of Census size classes. K = 1   0 -4 employees; K = 10   2,500 employees.

L - Counter used for manual direction of program through input from terminal

N - Phasing index. Corresponds to the first four years of a five year phasing program.

Variables

AVG(K) - The average size in each firm size class; used in interpolation

E72B(I,J) - total employment in 1972

E75B(I,J) - total employment in 1975

EINT - total employment in one SIC code and region as determined by interpolation; used in parameter check option

TABLE I-4

PROGRAM LISTING

```
FORTRAN IV G1  RELEASE 2.0               MAIN              DATE = 78293           15/18/17

                    DIMENSION NSIZE(19,10,10),HAZEXC(19,10),HAZREG(19,10),FRMEX(19,10)
                   *,E75B(19,10),E72B(19,10),FACT(19),KMAX(10),KRNG(10),AVGK(10),
                   *PHTAR(4),ICOM(6),FXC(20,11),REG(20,11),TOTF(20,11),FRMREG(20,11),
                   *PTFM(20,11),REMP(10)
              C
              C   THIS PROGRAM DETERMINES THE AMOUNTS OF HAZARDOUS WASTES WHICH
              C   WOULD BE EXCLUDED FROM EPA (RCRA) CONTROL IN ANY YEAR AT ANY GIVEN
              C   GENERATON LIMIT.  IT CAN ALSO BE USED TO CALCULATE THE NECESSARY
              C   GENERATION LIMITS TO ACHIEVE A FIVE YEAR PHASE-IN TO FULL REGULATION
              C     - WRITTEN BY R HOLBERGER, JUNE 1978, PROJECT - 15530
              C
                    DATA ICOM/'PRT','CMP','CHG','END','PCK','CYC'/
                    DATA IY/'Y'/
                    DO 1 I=1,19
                    DO 1 J=1,10
                    READ(5,1000)(NSIZE(I,J,K),K=1,10)
               1000 FORMAT(10I5)
                  1 CONTINUE
                    READ(5,1001)(FACT(I),I=1,19)
               1001 FORMAT(10F8.3)
                    READ(5,1000)(KMAX(I),I=1,10)
                    READ(5,1002)(AVGK(I),I=1,10)
               1002 FORMAT(10F8.3)
                    READ(5,1000)(KRNG(I),I=1,10)
                    DO 2 I=1,19
                  2 READ(5,1002)(E75B(I,J),J=1,10)
                    DO 3 I=1,19
                  3 READ(5,1002)(E72B(I,J),J=1,10)
                    DO 4 I=1,20
                  4 READ(5,1111)(TOTF(I,J),J=1,11)
               1111 FORMAT(11F6.1)
                    READ(5,1003)RATE,GLIM,NYR
               1003 FORMAT(2F8.3,I2)
                    DO 9 J=1,11
                    DO 9 I=1,19
                  9 TOTF(20,J)=TOTF(20,J)+TOTF(I,J)
                    WRITE(1,1050)NYR
                    READ(2,1006)MCOM
               1050 FORMAT(' DEFAULT PARAMETERS ARE 19',I2,', GEN LIMIT='/' 1.2 METRIC
                   * TONS- IF YOU WANT TO CHANGE'/' ENTER: CHG')
                    MM=0
                    IF(MCOM.EQ.ICOM(3))GO TO 59
                    GO TO 5
                 80 WRITE(6,999)NYR
                999 FORMAT('1',14X,'19',I2/'   GLIM   PRCT  HZRG   PTFM   NFRMS')
                    MM=1
                    DO 101 IJK=1,17
                    IF(IJK.GT.4)GO TO 102
                    GLIM=25.*IJK
                    GO TO 104
                102 IF(IJK.GT.12)GO TO 103
                    GLIM=50.*(IJK-2)
                    GO TO 104
                103 GLIM=100.*(IJK-7)
                104 CONTINUE
              C     BEGIN COMPUTATION CYCLE- INITIALIZE ALL PARAMETERS
                  5 DO 6 J=1,10
                    DO 6 I=1,19
                    HAZEXC(I,J)=0
                    HAZREG(I,J)=0
                  6 FRMEX(I,J)=0
                    DO 17 I=1,20
                    DO 17 J=1,11
                    FXC(I,J)=0.
                    REG(I,J)=0.
                 17 FRMREG(I,J)=0.
                    YRATE=RATE**(NYR-75)
                    DO 30 J=1,10
                    DO 20 I=1,19
              C     ISFM= SMALLEST FIRM SIZE REGULATED
```

TABLE I-4 (CONTINUED)

```
      ESFM=GLIM/(FACT(I)*YRATE)
C     CHECK FOR CUTOFF CLASS >10
      IF(ESFM.GT.KMAX(10))GO TO 22
C     DETERMINE CUTOFF CLASS
      DO 10 K=1,10
      IF(KMAX(K)-ESFM)10,11,11
   10 CONTINUE
   11 KK=K-1
      EMP=0
C     CHECK FOR CUTOFF CLASS= 1
      IF(KK.EQ.0)GO TO 13
      GO TO 23
   22 KK=10
C   COMPUTE NO. EMP,FIRMS IN CLASSES BELOW CUTOFF
   23 DO 12 L=1,KK
      FRMEX(I,J)=FRMEX(I,J)+NSIZE(I,J,L)
   12 EMP=EMP+AVGK(L)*NSIZE(I,J,L)
C     CHECK FOR CUTOFF CLASS >10
      IF(ESFM-KMAX(10))14,14,24
C   COMPUTE NO. EMP,FIRMS IN CUTOFF CLASS - (LINEAR INTERP)
C     CUTOFF CLASS= 1 (KK=0)
   13 FRMINC=ESFM*NSIZE(I,J,K)/4
      FRACTE=ESFM/8
      GO TO 15
C     ALL OTHER CLASSES (K=2-10)
   14 FRMINC=(ESFM-KMAX(KK))*NSIZE(I,J,K)/KRNG(K)
      FRACTE=(ESFM-KMAX(KK)-1)/2
C     TOTAL FOR ALL CUTOFF CLASSES
   15 FRMEX(I,J)=FRMEX(I,J)+FRMINC
      EMP=EMP+FRMINC*FRACTE
C   COMPUTE HAZWST REGD,EXCD BY SIC,REGION
      HAZEXC(I,J)=EMP*FACT(I)*YRATE*E75B(I,J)/E72B(I,J)
      HAZREG(I,J)=E75B(I,J)*10**3*FACT(I)*YRATE-HAZEXC(I,J)
C     CHECK FOR INTERPOLATION DISTORTION
      IF(FRMEX(I,J).GE.TOTF(I,J))GO TO 24
C     CHECK FOR SCALE-UP DISTORTION
   26 IF(HAZREG(I,J).GE.0.0)GO TO 16
   24 HAZREG(I,J)=0.0
      HAZEXC(I,J)=E75B(I,J)*10**3*FACT(I)*YRATE
C   SUM BY REGION
   16 REG(I,J)=HAZREG(I,J)/10**3
      REG(20,J)=REG(20,J)+REG(I,J)
      EXC(I,J)=HAZEXC(I,J)/10**3
      EXC(20,J)=EXC(20,J)+EXC(I,J)
      FRMREG(I,J)=TOTF(I,J)-FRMEX(I,J)
      IF(REG(I,J).GT.0.)GO TO 25
      FRMREG(I,J)=0.
   25 IF(FRMREG(I,J).GE.0.)GO TO 21
      FRMREG(I,J)=0.0
   21 FRMREG(20,J)=FRMREG(20,J)+FRMREG(I,J)
   20 CONTINUE
C   TOTAL ALL REGIONS
      REG(20,11)=REG(20,11)+REG(20,J)
      EXC(20,11)=EXC(20,11)+EXC(20,J)
      FRMREG(20,11)=FRMREG(20,11)+FRMREG(20,J)
   30 CONTINUE
C   SUM BY SIC
      DO 35 I=1,19
      DO 35 J=1,10
      REG(I,11)=REG(I,11)+REG(I,J)
      EXC(I,11)=EXC(I,11)+EXC(I,J)
   35 FRMREG(I,11)=FRMREG(I,11)+FRMREG(I,J)
      DO 45 I=1,20
      DO 45 J=1,11
   45 PTFM(I,J)=100.*FRMREG(I,J)/TOTF(I,J)
      THZRG=REG(20,11)*10**3
      THZEX=EXC(20,11)*10**3
      PRCT=100.*THZRG/(THZRG+THZEX)
      IFRM=FRMREG(20,11)+0.5
      IF(MM.EQ.0)GO TO 81
      THZRG=THZRG*1.E-6
  101 WRITE(6,888)GLIM,PRCT,THZRG,PTFM(20,11),IFRM
  888 FORMAT(2X,F5.0,2X,F5.1,2X,F4.1,2X,F5.1,2X,I6)
      WRITE(6,900)
```

TABLE I-4 (CONTINUED)

```
      MM=0
      WRITE(1,1013)
      GO TO 60
   81 EXMO=GLIM*1000./12
      WRITE(1,1004)GLIM,EXMC,PRCT,THZRG,PTFM(20,11),IFRM,NYR
      WRITE(6,1004)GLIM,EXMC,PRCT,THZRG,PTFM(20,11),IFRM,NYR
 1004 FORMAT(/' GENERATION LIMIT= ',F9.2,' METRIC TONS'/' (',F8.0,' KG/M
     +O)'/' WOULD REGULATE ',F6.2,'%, OR ',E10.4/' METRIC TONS, AND ',F6
     +.2,'%, OR ',I6/' FIRMS IN 19',I2)
   60 WRITE(1,1005)
C  DECISION POINT
 1005 FORMAT(//' WHAT NOW? - ENTER:PRT(PRINT OUTPUT),'/' CMP(COMPUTE PHA
     +SING TARGETS),'/' CHG(CHANGE GEN LIMIT), PCK(CHECK PARMS)'/' CYC(C
     +YCLE GEN LIMIT), OR END')
      READ(2,1006)NCOM
 1006 FORMAT(A3)
      DO 65 I=1,6
      IF(NCOM.EQ.ICOM(I))GO TO 66
   65 CONTINUE
      I=7
   66 CONTINUE
      GO TO (67,68,69,70,50,82,71),I
   71 WRITE(1,1007)
 1007 FORMAT(' ILLEGAL COMMAND--TRY AGAIN')
      GO TO 60
   82 WRITE(1,998)
  998 FORMAT(' ENTER YEAR')
      READ(2,*)NYR
      GO TO 80
   67 WRITE(6,1008) NYR,GLIM
C  PRINT HAZWST REGD AND EXCD BY SIC, REGION
 1008 FORMAT('1'/43X,'19',I2,' - GENERATION LIMIT',F9.2,' METRIC TONS/YR
     +'/46X,' ALL WASTES IN THOUSANDS OF METRIC TONS/YR'//1X,132('='))
      WRITE(6,1009)(I,I=1,10)
 1009 FORMAT(' SIC CODE',55X,'REGION'/16X,116('_')//10X,10(9X,I2),8X,'TO
     +T'/1X,132('_')/)
      DO 64 I=1,19
      II=20
      IF(I.EQ.1) GO TO 63
      II=20+I
   63 WRITE(6,1010)II,(REG(I,J),J=1,11)
 1010 FORMAT(2X,I2,' HW REG  ',10(F10.2,1X),F10.2)
      WRITE(6,1011)(EXC(I,J),J=1,11)
 1011 FORMAT(5X,'HW EXC  ',10(F10.2,1X),F10.2)
      WRITE(6,1012)(FRMREG(I,J),J=1,11)
 1012 FORMAT(5X,'FM REG ',10(F9.0,2X),F9.0)
   64 WRITE(6,1019)(PTFM(I,J),J=1,11)
 1019 FORMAT(5X,'% FM R  ',10(F10.2,1X),F10.2/)
      WRITE(6,1016)(REG(20,J),J=1,11)
      WRITE(6,1011)(EXC(20,J),J=1,11)
      WRITE(6,1012)(FRMREG(20,J),J=1,11)
      WRITE(6,1019)(PTFM(20,J),J=1,11)
 1016 FORMAT('+',132('_')//' TOT HW REG  ',10(F10.2,1X),F10.2)
      WRITE(6,980)
  980 FORMAT(1X,132('='))
      WRITE(6,900)
  900 FORMAT('1')
      WRITE(1,1013)
 1013 FORMAT(' OUTPUT PRINTED (HARD COPY)')
      GO TO 60
   68 DO 72 N=1,4
C                    COMPUTE PHASING TARGETS
   72 PHTAR(N)=N*THZRG/(5*RATE**(5-N))
      WRITE(1,1014)(PHTAR(N),N=1,4)
 1014 FORMAT(//' PHASING TARGETS ARE:'/1X,3(E9.4,','),E9.4/' METRIC TONS
     + FOR THE FIRST FOUR YEARS,'/' RESPECTIVELY'//)
      WRITE(6,1014)(PHTAR(N),N=1,4)
      GO TO 60
   69 WRITE(1,1015)
C                          CHANGE GEN LIMITS
 1015 FORMAT(' ENTER NEW YEAR, GEN LIMIT')
      READ(2,*)NYR,GLIM
      WRITE(1,1017)NYR,GLIM
```

TABLE I-4 (CONCLUDED)

```
 1017 FORMAT(' NEW VALUES ARE: NYR=',I2,','/' GENERATION LIMIT=',F9.2,/'
     + READY TO COMPUTE? - Y OR N')
      READ(2,1018)NCOM
 1018 FORMAT(A1)
      IF(NCOM.NE.IY)GO TO 69
      GO TO 5
C     CHECK EMPLOYEE RATIOS USED FOR SCALE-UP
   50 WRITE(6,1120)
      WRITE(6,1121)(I,I=1,10)
 1120 FORMAT('1'/21X,'EMPLOYEE RATIOS: 1975/1972'//)
 1121 FORMAT(2X,'SIC',29X,'REGION'//3X,10(4X,I2),4X,'TOT')
      TOT2=0.
      TOT5=0.
      DO 52 I=1,19
      T75E=0.
      T72E=0.
      DO 51 J=1,10
      T75E=T75E+E758(I,J)
      T72E=T72E+E728(I,J)
   51 REMP(J)=E758(I,J)/E728(I,J)
      ER=T75E/T72E
      TOT2=TOT2+T72E
      TOT5=TOT5+T75E
      II=20
      IF(I.EQ.1)GO TO 52
      II=20+I
   52 WRITE(6,1122)II,(REMP(J),J=1,10),ER
      ET=TOT5/TOT2
      WRITE(6,1124)ET
 1124 FORMAT(20X,'RATIO OF ALL TOTALS - ',F6.2)
 1122 FORMAT(2X,I2,11(2X,F4.2))
C     CHECK NUMBER OF EMPLOYEES BY INTERPOLATION OF FIRM SIZE DIST
C     AGAINST 72 EMPLOYMENT
      WRITE(6,1123)
      WRITE(6,1121)(I,I=1,10)
 1123 FORMAT(/////9X,'TOTAL EMPLOYEES BY INTERPOLATION/ GIVEN TOTAL- 197
     +2'//)
      TT=0.
      DO 56 I=1,19
      T72E=0.
      TEIN=0.
      DO 55 J=1,10
      EINT=0.
      DO 54 K=1,10
   54 EINT=EINT+NSIZE(I,J,K)*AVGK(K)
      T72E=T72E+E728(I,J)*10**3
      TEIN=TEIN+EINT
   55 REMP(J)=EINT/(E728(I,J)*10**3)
      TT=TT+TEIN
      RTE=TEIN/T72E
      II=20
      IF(I.EQ.1)GO TO 56
      II=I+20
   56 WRITE(6,1122)II,(REMP(J),J=1,10),RTE
      TTE=TT/(TOT2*10**3)
      WRITE(6,1124)TTE
      WRITE(6,900)
      WRITE(1,1013)
      GO TO 60
   70 CONTINUE
      STOP
      END
```

EMP - number of employees in one SIC code and region employed by firms exempt from regulation

ER - ratio of 1975 employment to 1972 employment for an entire SIC code; used in parameter check option

ESFM - number of employees in smallest firm subject to regulation

ET - ratio of total 1975 employment to total 1972 employment; used in parameter check option

EXC(I,J) - hazardous waste excluded from regulation, thousands of metric tons

EXMO - small generator exclusion limit, kg per month

FACT(I) - generation factor

FRACTE - average number of employees per firm in cut-off size class which are excluded from regulation; used in interpolation

FRMEX(I,J) - number of firms excluded from regulation

FRMINC - number of firms in cut-off size class which are excluded from regulation; used in interpolation

FRMREG(I,J) - number of firms regulated

GLIM - generation limit, metric tons per year

HAZEXC(I,J) - amount of hazardous waste excluded from regulation, metric tons

HAZREG(I,J) - amount of hazardous waste regulated, metric tons

ICOM(L) - alphanumeric commands for manual direction of program from terminal

IFRM - number of firms regulated, rounded to nearest integer

II - dummy index used to print proper SIC codes on output

IJK	- dummy index used to increment EXCL for cycling option
IY	- alphanumeric symbol for NO, used for manual direction from terminal
KK	- dummy variable used for interpolation, equal to the firm size class immediately below the cut-off class
KMAX(K)	- the largest firm size in a size class
KRNG(K)	- the range of firms sizes in any size class
MCOM	- dummy variable used to interpret commands from terminal
MM	- dummy variable used to control printout for cycling option
NCOM	- dummy variable used to interpret commands from terminal
NSIZE(I,J,K)	- number of firms in each firm size class
NYR	- year of interest, last two digits
PHTAR(N)	- targets for first four years of phasing alternative, total hazardous waste regulated
PRCT	- percentage of total wastes which would be regulated
PTFM(I,J)	- percentage of total firms which would be regulated
RATE	- annual growth rate for waste generation
REG(I,J)	- hazardous wastes regulated, thousands of metric tons
REMP(J)	- employee ratio; used as output variable for both functions of the parameter check option
RTE	- ratio of total employment in one SIC code in all regions by interpolation to reported total, used in parameter check option
T72E	- total reported 1972 employment in one SIC code in all regions; used in parameter check option

T75E - total reported 1975 employment in one SIC code in all regions; used in parameter check option

TEIN - total employees in one SIC code in all regions as determined by interpolation; used in parameter check option

THZEX - total hazardous waste excluded, all SIC codes in all regions, metric tons

THZRG - total hazardous waste regulated, all SIC codes in all regions, metric tons

TOT2 - total reported 1972 employment, all SIC codes in all regions; used in parameter check option

TOT5 - total reported 1975 employment, all SIC codes in all regions; used in parameter check option

TT - total employees in all SIC codes in all regions as determined by interpolation; used in parameter check option

TTE - ratio of total employees in all SIC codes in all regions determined by interpolation to reported total; used in parameter check option

YRATE - multiplier to adjust waste generation to any given year: YRATE = RATE**(NYR-75)

APPENDIX J

HAZARDOUS WASTE INCIDENTS

A total of over three hundred incidents involving hazardous wastes have been selected from the EPA open files (Office of Solid Waste, Hazardous Waste Management Division, 1978b). These incidents are summarized in this appendix in order to document the kinds of accidents that could be reduced or eliminated by implementation of the proposed regulations. Incidents involving household wastes are included even though such waste would not be regulated. It is believed that public participation procedures and state administration of programs will serve to increase public awareness and education; thus, resulting indirectly in a decline of public health problems related to household wastes.

J.1 Generation Incidents

- In 1971, 6,140 fish were killed in Spring Creek from a spillage of waste liquid by a secondary chemical processor in Centre County, Pennsylvania. The spill was caused by an unattended hose that moved from a position of pumping waste liquid into an impoundment to one of pumping into a ditch. From the ditch, 12,000 gallons of waste liquid from the company's neutralization basin flowed into Spring Creek, causing a fish kill extending 4.7 miles downstream. Contaminations with the polluted water included cyanide, iron, phosphate, nitrates, and various organic chemicals. Other fish kills in Spring Creek attributable to the same company have occurred on five other occasions.

- A chemical residue inside a plant in Hopewell, Virginia, plus a large amount of Kepone, was emitted into the air, sewer, and water systems. Air pollution readings indicated that 55 percent of the dust in the air was Kepone. As chemical wastes were flushed through the Hopewell sewer systems, the best shad and oyster waters of the James River from Richmond to Newport News were contaminated. The James River was closed to fishing in December 1975.

- Celery farmers in Muskegon County, Michigan, reported the presence of a film of gasoline on the water surface in a sumphole in August 1975. The gas film was volatile enough that fumes were noticeable in the celery greenhouses. Analysis of the film showed that in addition to hydrocarbons, 510 ppm lead was also present. The source of the oil was a nearby refining company which was responsible for many spills and oil leaks in its oil field. Oil-containing water from previous spills was required to be collected and treated in two ponds, one of which was continuously monitored. Since the company was in the process of dismantling, no further pollution was expected to emanate from it.

- Three industrial supply wells in Warren County, New Jersey, were contaminated by ammonia and mercury-laden wastes in 1971. The wastes were leaked from a chemical manufacturing plant, subsequently entering the water table. The plant had discontinued its mercuric waste stream, but apparently, the groundwater quality problem still exists.

J.2 Transport Incidents

- A truck driver noticed that one of the drums he was hauling through the village of Mundelein, Illinois was leaking titanium trichloride, a chemical that changes to an hydrocloric acid mist on contact with the air. Fourteen people were hospitalized for exposure to the fumes. The four drums of chemicals were neutralized and buried.

- Several dozen barrels of chemical wastes, believed to be sodium nitrate, exploded in a truck bin on the Dan Ryan Expressway in Chicago, spewing barrels of flames over cars and snarling rush-hour traffic. The chemical was part of a load being carried by an industrial garbage truck to a garage in Crestwood from a chemical company. Barrels which were catapulted into the air landed among the cars or dropped 50 feet to the ground below the expressway. Two Deering District policemen stopped traffic near the scene, and were later treated briefly at Mercy Hospital for eye injuries from the smoke. Both were released. The cause of the fire was unknown.

- In the San Francisco Bay area, an attempt was made to recover alkyl lead from organic lead wastes. The wastes were transported by truck to a recovery plant. Toll collectors on a bridge along the truck route to the recovery plant became ill as a result of vapors escaping from the transporting truck.

- A hauler was unloading drums of flammable waste from a truck at a disposal site in California. One of the drums, when disturbed, exploded or ruptured and the truck was immediately engulfed in flames. The truck was a total loss, but no one was hurt.

- In southern Louisiana, industrial wastes containing hexachlorobenzene (HCB), a relatively volatile material, were transported over a period of time to municipal landfills in uncovered trucks. High levels of HCB have since been reported in the blood plasma of individuals along the route of transport. In a sampling of 29 households along the truck route, the average plasma level of HCB was 3.6 ppb, with a high of 23 ppb.

- A leak of 500 gallons of carbolic acid from the ruptured tank of a truck that had stopped for fuel in Union, Connecticut, contaminated at least three shallow wells on the Connecticut side and filtered into the Hamilton Reservoir in Massachusetts.

J.3 Treatment and Lagoon Incidents

- Two deaths occurred as a result of a tank accident at a treatment plant in 1975. The two youths involved were cleaning scale from a cyanide plating waste tank and were using their safety equipment when checked during the afternoon. The cyanide level in the tank had been checked, there was positive purge in the air lines, and the victims were wearing gas masks at that time. When the bodies were found, the compressor for the purge had been turned off and the gas masks had been removed - reason unknown. (Apparently, a cyanide pocket was hit.)

- Sulfide waste was added to soluble oil waste in a tanker and subsequently added to other oily wastes. Later treatment of the oil with acid to break the emulsified oil resulted in evolution of hydrogen sulfide. Two operators were briefly affected, and there was an explosion in the tank.

- In July 1977, several truckloads of organohalides, amines, and hydrocarbons were dumped by a waste disposal firm at a disposal site near San Francisco, California. The wastes were deposited in an evaporation pond, where they soon floated to the top and began to evaporate. A visible and odoriferous plume of white mist hovered over the area for several hours, provoking nausea and other complaints from residents downwind of the site. One or more buildings in the area were evacuated as a result of the serious air pollution incident.

- A pesticide company makes Carofuran, which hydrolyzes at 10 pH. Some of this chemical escaped without proper treatment during the summer of 1975 into a lagoon used by the company to store high pH ammonia-containing wastes. Ducks and geese which normally use the lagoon were killed by the Carbofuran content. Since acidification would release large amounts of ammonia gas, the plan is to drain the lagoon into Jeddo Creek at a dilution that would release Carbofuran at a 0.08 ppm concentration.

- In 1967, in Carbo, Virginia, a dike containing an alkaline waste lagoon for a steam generating plant collapsed and released fly ash waste into the Clinch River. All food organisms in the four-mile stretch of river immediately below Carbo were completely destroyed. The contaminant flowed from Carbo to Norris Lake in Tennessee, where it is estimated to have killed 216,200 fish.

- Aquatic life in Jack's Creek has been severly depressed due to discharge from the waste impoundments of a chemical company in Mifflin County, Pennsylvania. Leakage from the impoundments produced high concentrations of zinc, copper, iron, and sulfide in the groundwater and in the nearby creek. Lagoons have subsequently been phased out.

- Two fish kills were noted in August and November 1975, in the Crow River near Hutchinson, Minnesota. It was determined that they were caused by cyanide levels as high as 0.31 mg/l in the stream. The source was a wastewater treatment plant that received ferrocyanide from a local industry. Ferrocyanide dissociates in the presence of sunlight to release ionic cyanide that forms hydrocyanic acid, a process which is accelerated with decreasing pH. Therefore, the fish kills were only noticed during periods when the pH of the river or sewage effluent was lower than normal.

- In Fort Meade, Florida, a portion of a dike forming a waste pond ruptured, releasing an estimated two billion gallons of slime composed of phosphatic clays and insoluble halides into Whidden Creek. Flow patterns of the creek led to subsequent contamination of Peace River and the estuarine area of Charlotte Harbor, which acquired a milky white appearance. Along the river, signs of life were diminished; dead fish were sighted and normal surface fish activity was absent. No living organisms could be found in Whidden Creek or in Peace River up to eight miles downstream. Clams and crabs gills were coated with the milky substance.

- In 1965, unlined lagoons in Colombia County, Pennsylvania, caused contamination of private wells in the area. The lagoons were leaking plating wastes containing cyanide, copper, nickel, alkylbenzenesulfonate, and phosphate.

- In December 1973, overflow from a waste impoundment at a chemical company in Clinton County, Pennsylvania, caused pollution of Bald Eagle Creek. The prime contaminants of the polluted waters were copper, chromium, and iron. In addition to the degradation of the stream quality, the overflow also saturated soil around the Pennsylvania Railroad, causing the derailment of several cars.

- A trucking firm in Lake County, Ohio, hauls bulk chemicals in trailer tanks and washes residues from the trailer tanks into two lagoons on the firm's property. The unlined lagoons receive about 5,000 gallons per day of wastewater containing phenols, organic solvents, phosphates, and suspended solids. Contamination of wells on adjacent property was reported in 1971; and cattle refused to drink from a stream polluted by effluent from the lagoons.

- In 1972, in Dakota County, Minnesota, the presence of phenols, fuel oil, ammonia, increased dissolved solids and depressed water pH in domestic wells is attributed to leakage from lagoons used for disposal of liquid wastes by several industrial plants. Several owners of private wells have complained of pumping water of poor quality. There is concern over the danger of contaminating the Jordan Sandstone where improperly constructed wells may allow hydraulic connection with the overlying contaminated aquifers.

- Seepage from eight (8) lagoons in Montgomery County, Pennsylvania, has contaminated groundwater, springs, and swamps in the area. The company processes fluorocarbons for use in manufacturing teflon and disposes the ammonia wastewater in their lagoons. Samples of seepage downslope from lagoons contained 3,000 mg/1 NH_3, 28.8 mg/1 F, and 1,800 chemical oxygen demand. The wastes were pumped to a municipal treatment plant.

- In 1955, a steel company in Bucks County, Pennsylvania, stopped using a drinking well on their property due to high iron levels found in the water. These iron levels have been attributed to leachate from the 13 industrial waste lagoons maintained on the property. In 1958, another well was abandoned when iron concentrations exceeding 15 ppm were discovered in the water. A comprehensive groundwater analysis conducted in 1975 revealed an iron concentration consisting of 76 ppm, 125 ppm phenols, and 34.6 ppm ammonia.

- A pharmaceutical firm in Myerstown, Pennsylvania, made a chicken vaccine prior to 1966. Resultant arsenic wastes were deposited in a lagoon as sludge behind the plant. In 1966, another company bought the property and discovered that a large area of the groundwater was contaminated. High arsenic levels were detected in nearby Tulpehocken Creek, and trace amounts could be detected as far as the Philadelphia Water Supply on the Schuylkill River. Use of the lagoons was discontinued and the contaminants were stored in 55-gallon barrels with polyethylene plastic liners.

- The breakage of one of the walls of a sludge lagoon in 1970 resulted in the spillage of sludge into the Schuylkill River. The sludge was a residue from the operations of a waste lubricating-oils refinery in Berks County, Pennsylvania. During a legal struggle between the company and the state over the incident in 1972, Hurricane Agnes floods washed sludge out of the lagoons and into the Schuylkill River, causing more damage downstream. A partially successful cleanup operation was completed in 1973.

- In the 1960's, chromium from an industrial waste lagoon in Newfield, New Jersey, contaminated one municipal well, at least one domestic well, and a nearby stream. The lagoon had been operating for about ten years before the problem was recognized in 1970. At that time, a total hexavalent chromium concentration of 150 ppm was measured in one of the wells 700 feet away from the waste lagoon. The source of contamination has been eliminated, but the plume of polluted groundwater remains.

- From 1966 to 1969, spent bomb casings containing the explosives RDX and TNT were washed out and the wastewater sent to an unlined settling basin in Kitsap County, Washington. In 1971, levels up to 0.32 ppm nitrates were discovered in area water wells. Concentrations of 5.2 ppm RDX and 113 ppm TNT were found in the water and up to 5 ppm of each were found in the soil. Testing revealed that contaminants had penetrated the perched water table below the basin.

- Groundwater contamination from waste lagoons containing domestic, commercial, and industrial wastes occurred near Yakima, Washington. Nearly one-half of the ponded material consisted of industrial wastes. Within a few months after discharge to the pond began, a nearby well became contaminated with coliform bacteria that had migrated from the lagoon. Sewage infiltrating through the bottom of the lagoon formed a shallow, elongated mound of fluid that rested on top of the water table. Contaminated water from the lagoon reached rural water wells down the valley in six days.

- Leachate from the waste pond of a fertilizer plant in Hertford County, North Carolina, has contaminated groundwaters and the Chowan River. The pond contained high nitrogen waste waters which leached into a sand aquifer and into a freshwater pond leading to the river. The total amount of nitrogen in the sediments was computed to be 465 tons. The quick pace of nitrogen seepage into the river was slowed by digging a lined ditch between two of the waste water ponds to prevent water from moving into the underlying contaminated sediments. Other measures were also taken to ensure good surface drainage toward an open ditch, thereby minimizing movement of rainwater into contaminated sediments.

- Leachate from three ponds containing aluminum oxide slurry was the source of pollution of the New River, North Carolina, in 1972. The ponds are owned by an electric company which makes resistors with aluminum coatings. The ponds apparently sealed themselves, since leachate was not detected in 1974 or 1975.

- Demineralization facilities of a chemical plant became overloaded in July, 1966, because of a marked high in mineral content of the groundwater from one of its five production wells. By October, 1966, the situation was critical and plant shutdown seemed imminent. It was discovered then that the most severely polluted well was located adjacent to the plant's concrete-lined sewers and waste ponds. It was suspected and confirmed that cracks in these liners were the points of pollution entry. Successful corrective measures were undertaken and completed.

- The Air Compliance Division of the Connecticut Department of Environmental Protection closed down two organic solvents recovery operations in Southington, Connecticut, that were emitting air pollutants caused by waste incineration. Lead and zinc contaminated area groundwater and the company's own well. Waste incineration was ceased in early 1974.

- Evaporation ponds at the site of an industrial company in Concord, California, persistently caused air pollution problems. Of the four ponds located there, two are used for biodegradation of material from oil refineries and two receive wastes for evaporation. In the summer, air pollution citations increase because of the very bad odors that can carry for many miles. A large percentage of the waste materials are significantly more volatile than water.

- In Ottawa County, Michigan, lagoons belonging to a private waste disposal operation receiving liquid industrial wastes leaked heavy metals and other chemicals into the groundwater.

- In 1968, in Jobos, Puerto Rico, wastewater from a fiber plant seeped through a permeable bottom of a small lagoon. Water from a public supply well nearby developed a persistent and offensive odor.

- In 1971, a newly drilled industrial well in an artesian aquifer in Garfield, New Jersey, contained water with an unacceptably high concentration of phenolic materials. The pollutants originated from nearby industrial waste lagoons.

- In 1971, overflows and leachate to groundwater from an industrial waste lagoon in East Greenbush, New York, produced foul odors and an oil slick in a nearby stream.

- As a result of heavy rains in February of 1973, a dike in Camden County, New Jersey, broke, releasing 70,000 gallons of Latex paint sludge into Hilliard Creek. Laboratory analysis of creek water revealed that the sludge contained 2,300 ppm lead and 17.2 ppm mercury.

- Leakage from a series of large impoundments filled with acid and sludge wastes treated with sulfuric acid contaminated groundwater in Delaware County, Pennsylvania.

- Several wells in Clinton County, Pennsylvania, became unusable in 1973, due to high concentrations of iron, manganese, and chlorine found in the water. The sources of the contaminants were leaking impoundments, seepage beds, and spray fields belonging to a gas compression company. Wastes from the company had been dumped at these sites since the early 1960's.

- In Franklin County, Pennsylvania, surface water pollution and possibly groundwater pollution at a center for chemical warfare has resulted from leachate and direct stream discharge from two concrete-lined acid sludge lagoons.

- In 1972, leachate from two waste chromium lagoons in York County, Pennsylvania, contaminated a nearby stream. Analysis of the supernatant in the lagoons revealed chromium concentrations of 0.23 mg/l and 0.15 mg/l, which are greatly in excess of the drinking water limit. The lagoons were abandoned in 1975.

- In 1971, in Bergen County, New Jersey, phenolic materials from industrial waste lagoons were added to local recharge. A newly drilled industrial well produced water with an objectionable concentration of phenolic material.

- In 1964, in Lebanon County, Pennsylvania, arsenical wastes were released into an unlined lagoon and subsequently seeped into the subsurface. Groundwater in the water table aquifer in the immediate vicinity of the waste lagoon was found to contain as much as 200 mg/l of arsenic.

- In Sharon, Connecticut, an overflow pipe regularly sent ethylene glycol into the groundwater and wells, thereby contaminating them.

- In the late 1960's, an industrial waste processing firm in Gloucester County, New Jersey, began treatment and disposal operations using a series of lagoons that covered an area of about 15 acres. Soon chemical pollutants leaked into the groundwater. By 1972, the volume of polluted groundwater was estimated at 20 x 10^6 gallons. Analysis of the groundwater yielded the following results: chromium 150 ppm; copper 135 ppm; zinc 50 ppm; nickel 19 ppm, and 5,000 chemical oxygen demand. The lagoons have since been sealed with cement and plastic liners, and pumping and treatment of the groundwater has been successful in containing the problem.

- A 1971 analysis of a residential well in Pine Bend, Minnesota, showed an unusually high content of ammonia. Chemical contamination of groundwater from three nearby industries was confirmed. Nearby counties were discharging to retaining ponds very large quantities of wastewater and sulfuric acid which were seeping to the subsurface and eventually into the aquifer. A new well constructed in 1972 also showed pollution of groundwater as evidenced by the very high total solids, low pH, ammonia, high sulfate content, and the presence of high concentrations of lead, copper, and zinc.

- Leachate from a waste lagoon in Port Jervis, New York, contaminated the water table. Fluoride concentrations greater than 50 ppm were discovered in a nearby spring. The plant was abandoned.

J.4 Storage Incidents

- In 1977 in New Jersey, a 20,000 gallon tank filled with hydrocarbon at a chemical disposal plant exploded, possibly due to a welding spark. Fire spread to 11 other storage tanks. Two workmen were killed and ten others were injured--four critically. Another four workmen were reported missing.

- A disposal company collected several drums of paint solvent from a generator and transported them at night to a landfill in Burnsville, Minnesota. The following day, a bulldozer operator collided with the drums, rupturing them and igniting the flammable solvent. The operator was burned over 85 percent of his body and was crippled.

- An employee transferred two five-gallon cans of waste vinyl cyanide and water from a still to a supposedly empty waste drum. As the employee rolled the drum to a storage area across the road, it exploded. Waste material sprayed the employee. The drum was thrown approximately 48 feet, wrapping around a steel guard post. The employee received thermal and possible chemical burns to both feet. The exothermic reaction that caused the drum to rupture, was probably a combination of cyanoethylation and polymerization.

- An 11 year old boy suffered severe alkaline burns at a creek near storage tanks of sodium hydroxide. The boy apparently jumped across the creek and suffered third degree burns when his leg sank up to the knee in mud. He underwent surgery immediately to remove the dead tissue from his burned leg and ankle. Sheriff's reports indicated that two other boys had suffered similar burns the previous week in the area. The environmental control officer recommended that the company close the valves on its storage tank and flood the area to neutralize the leak. One more person was to be injured, however, before the matter was resolved.

- From time to time in the last ten years, the entire Johnson family from Rockford, Illinois, had been stricken with headaches and stomachaches, listlessness, "water" behind the ears, shakiness, and other symptoms (that may have been mercury poisoning) that would last for weeks, subside briefly, and then return. In the spring of 1972, the family learned that their well water was tainted when they detected a strong industrial odor coming from it, the same odor they smelled coming from drums of chemical wastes stored on their neighbor's farm. Chemical wastes from these drums either had leaked or had been dumped into an abandoned limestone quarry.

From there the wastes had filtered down to the water table and entered the family well. A paint manufacturer in Rockford was sued by the family for disposing waste solvents, mercury, and chemicals. The company was ordered to stop dumping there; however the mercury contamination persisted.

- At a drum reclaiming plant in northern California, 15 men were poisoned by gases given off from drums. It is presumed that this incident occurred because of inadequate storage procedures by the company involved.

- In 1971, a fire occurred in a warehouse in Okanogen County, Washington, where about two tons of pesticides were stored, including guthion, parathion, endrin, dieldrin, DDT, and other chlorinated hydrocarbons. The threat of health impairment from the toxic fumes emitted from the fire forced the evacuation of nearby residents for several hours. Runoff of water used to extinguish the fire polluted a city well 500 feet away from the site with endrin and nitrate. Expectant mothers and small children were advised not to drink the city water for about two weeks.

- When a hydrochloric acid mist blanketed a housing project in Chicago, about 200 residents were hospitalized and thousands were driven from their homes. The acid mist came from a leaky storage tank containing silicon tetrachloride, which turns into hydrocloric acid when it reacts with moisture from the atmosphere. The leak was not sealed for days - after 350,000 gallons of the chemical had already been spilled.

- In Richmond, California, a hazardous waste hauler mixed a liquid waste containing butyl acetate in xylene, with an etching waste containing sulfuric acid, nitric acid, and hydrofluoric acid. A hydrolysis reaction took place. Pressure was generated in the tank and the safety relief valve was blown off while the truck was traveling through a residential area. A private residence was sprayed with the hazardous mixture.

- In 1973, a major chemical company in Virginia contracted with a processing firm in Alabama to pick up, haul, and dispose of approximately 10,000 drums of aramite waste, containing 30 to 80 percent sulfuric acid. Most of the wastes were shipped in 208 liter (55-gallon) steel drums and 190 liter (50-gallon) fiber drums. The wastes brought to Alabama were never processed and remained in two open storage areas and in one inclosed warehouse. Due to weathering, physical stress, and the corrosive and harsh nature of the wastes, many of the drums stored in the two open areas disintegrated and their contents spread over the adjacent ground. In addition to contamination of local waters (chemical analysis of samples of drainage water from the storage site indicated a very high acidity and high concentrations of heavy metals), the storage of waste at the three locations presented a great fire hazard. On March 9 and 10, 1976, a fire broke out at the site, and two firefighters became ill, presumably due to inhalation of toxic fumes.

- On at least two occasions waste storage lagoons have broken, spilling large volumes of wastes into the Allegheny River in Pennsylvania. On one occasion in 1968, a waste refining sludge containing oils, acid wastes, and alkyl benzene sulfonate flowed three miles down a tributary to the Allegheny, killing 4.5 million fish. On another occasion in 1972, heavy rains broke the dike of another refinery waste lagoon, killing 450,000 fish along a 60-mile stretch of the river. The discharge was characterized by a pH of 1.7, chemical oxygen demand of 116,112 ppm, iron concentration of 507 ppm, and sulfate concentration of 56.5 ppm.

- Lagoonal wastes from a company in Noxamixon Township, Pennsylvania, had been the source of groundwater, stream, and soil contamination there. The company, which was in operation from 1965 to 1970, bought industrial wastes from other plants, extracted copper, and stored the rest of the toxic liquids in lagoons. Three of the cement lagoons developed open seams on the bottom, seeping fluids into a nearby creek. During at least one period of heavy rainfall, toxic wastes from the lagoon, including acids, copper, nickel, and iron chloride, flooded into a nearby creek. Soil contamination persists at the site, and the entire area is devoid of vegetation.

- In 1969, in Carbon County, Pennsylvania, heavy metals leached from a slag pile at a zinc smelter to the water table and moved laterally to Aquashicola Creek. Groundwater containing up to 200 mg/l zinc and 2.5 mg/l of other heavy metals was discharged into Aquashicola Creek and adversely affected aquatic life.

- An Oconto County, Wisconsin, chemical company that stored salt wastes onsite from the production of herbicides caused ground and surface water contamination.

- Phenolic substances released into Oil Creek from an open gate valve in a retention lagoon at a chemical company in Venango County, Pennsylvania, were apparently responsible for a moderate fish kill and the death of some turtles which the creek supported.

- A copper reclamation company, located in a mid-Atlantic state, bought industrial wastes from other plants, extracted the copper, and stored the remaining liquids in cement lagoons. Three of the lagoons developed open seams and leaked toxic pollutants into an adjacent creek, killing all its aquatic life. After an injunction was issued requiring the wastes to be treated, the company defaulted, leaving 3-1/2 million gallons of toxic wastes on the site. Heavy rains in April 1970, overflowed the lagoons into a tributary of the Delaware River, forcing county officials to build a dike around the area. The wastes were finally neutralized and ocean dumped.

- Leachate from a two-acre fiberboard waste pile in Nash County, North Carolina, has contaminated a stream with high concentrations of nitrogen and manganese. The waste pile consists of waste wood fibers and is 6-10 feet deep. The high manganese concentrations have caused problems in the city of Rocky Mount's water treatment plant. Disposal to the pile has since been discontinued.

- A holding pond and tanks failed at a Saltville, Virginia, chemical manufacturing plant, spilling chlorine, hypochlorite, and ammonia into the Holston River. River water samples showed a hypochlorite level of 0.5 ppm and a fixed ammonia concentration of 17.0 ppm. Dead fish were sighted along the river.

- A firm engaged in the disposal of spent chemicals was storing and disposing toxic chemical wastes at two Louisiana locations. At one of these sites, several thousand drums of waste (some with and some without lids) were in storage. Many of the drums were popping their lids and leaking, and visible vapors were emanating from the area. The pine trees beside the storage area were all killed as a result of this leakage.

- An arsenal was established in 1943 by the U.S. Army for the production of chemical warfare agents. In the late 1950's, the site was used by a chemical company for the manufacture of pesticides and herbicides. Liquid chemical wastes were conveyed by canals and ditches to unlined holding ponds for storage. It was noticed that crops on local farms were being damaged. During the following years, damage became acute, and in 1957, a 96-acre asphalt reservoir was constructed to contain the wastes. In addition, a 12,000 foot-deep injection well was dug for ultimate disposal of the wastes. Injection was halted when it was correlated with earthquakes in the Denver area. Sampling in 1965 showed severe groundwater contamination covering at least 12 square miles. Contaminates included chloride, sodium, fluoride, arsenic, chlorate, 2, 4-D, aldrin, and dieldrin. Chloride concentrations as high as 3,000 to 4,000 ppm were observed in the contaminated areas. As of 1975, contamination was still evident with aldrin, endrin, and dieldrin present in the 30-40 ppb range. The present area of contamination extends over 30 square miles, 25 of these off-site. The plume now extends to within a mile of the public water supply well field for the city of Brighton.

- A manufacturer of agricultural herbicides in Oconto County, Wisconsin, produces salt wastes containing arsenic that are stored on a loading dock within ten feet of the Menominee River. A well at the dock yields water containing about 1.0 mg/l arsenic. Heavy contamination of the groundwater, the soil, and the river is also reported, with maximum levels of arsenic in the sediment found to be 35 ppm. Two new storage facilities are to be constructed to hold the salt wastes.

- In 1969, overflow of storage tanks and some spray irrigation killed vegetation and polluted wells and groundwater in Lebanon County, Pennsylvania. The polluting wastewaters contained organic materials, blood, and chloride.

- In 1967, an industrial operation recovering metals from waste products moved near the municipal well field of Perth Amboy, New Jersey, and proceeded to stockpile materials containing zinc, lead, and cadmium in the open. These metals leached into adjacent surface and groundwaters, causing the closure of public water supply wells in 1971 and 1972, due to high zinc concentrations. The remainder of the well field is in jeopardy. A surface stream flows into a pond near the well field. Analysis revealed 12,250 ppm of zinc and 600 ppm of lead.

- Several drums of a 15 year old chemical used for soil sterilization were discovered in a warehouse in Bingham County, Idaho. The chemical was taken to a remote area where it was exploded with a rifle blast. Had it been disturbed only slightly while in storage several people might have been killed.

- Officials found 1,500 steel drums of wastes, some leaking chemicals, stored in the open just outside the city limits in Travis County, Texas. Subsequently, investigators found another 3,000 barrels of wastes stored in West Travis County. Four small chemical companies and one large plant in Houston were named as sources of the wastes.

- In the summer of 1972, approximately 1,000 pounds of arsenic-containing pesticide and a bottle of KCn, muriatic and nitric acid were discovered in an abandoned factory building in Camden County, New Jersey. The building previously belonged to a leather tannery that had discontinued its operations.

- Since 1867, asbestos product manufacturers have accumulated nearly 2 million cubic yards of assorted industrial wastes in open piles in a small Pennsylvania town. The original generator of the wastes went out of business in 1962. Since then, two other companies have been responsible for enlarging the spoils piles. The atmosphere around the piles contains asbestos fibers due to wind erosion. An air-monitoring program, conducted by the U.S. Environmental Protection Agency in October, 1973, indicated ambient background levels of asbestos to be 6 ng/m^3. An asbestos level of 9.6 ng/m^3 was found at a playground near the largest waste pile. Values obtained near active disposal piles range from 114 to 1745 ng/m^3. A high pH level in a nearby stream has resulted from runoff from the piles.

- In April 1974, in Bay County, Michigan, a private water well became contaminated by trichlorethylene (TCE). The well was replaced. Persistent complaints about water contamination by TCE prompted a search for a TCE source. This investigation revealed empty and full barrels of waste TCE stored at the back door loading area of the site.

- Groundwater contamination from gasoline polluted at least five water wells in Bexar County, Texas. A leak was detected in a gasoline storage tank at an abandoned service station which was operating when the reports of gasoline in well water first appeared.

- A sump overflow in 1971 allowed trichloroethylene wastes to leak into a cooling water pond. Seepage from this pond contaminated a private well 75 yards away. A company well was also contaminated with 1,500 ppm trichloroethylene. The company well was pumped to waste and presently levels are only 20 ppm.

- A waste oil company in East Greenbush, New York, operated a scavenger operation, utilizing earthern lagoons for storage. Subsequent overflows and leachate to groundwater caused odors and oil slicks in a nearby stream.

- In 1974, an underground water supply in Ocean County, New Jersey, was seriously polluted when several barrels containing potent chemicals leaked their contents into the ground at a landfill. The state was forced to close down the underground aquifer.

- Slag-pile leachate at a dump in Cambria County, Pennsylvania, has degraded waters in Hinckston Run. The dump contains paper, cardboard, steel filings, and pickling liquors. Stream samples of Hinckston Run revealed high concentrations of iron, sulfates, manganese, aluminum, and a low pH.

- Molybdenum wastes from a molybdenum oxide producing plant were piled in the open in Washington County, Pennsylvania. The uncovered slag pile was exposed to rainstorms, and runoff from the pile would periodically enter Burgetts Creek, where molybdenum was measured to be 50 ppm. Damage to the creek environment was difficult to assess, because the creek was also polluted by sewage and acid-mine wastes.

- Fifty-five gallon drums of liquid sludges from a company in New York leaked into a nearby stream, leaving an oily scum on the surface. The stockpiling site was abandoned, although old barrels still remain.

- A liquid waste disposal company spilled fish-killing chemicals into a small creek in the Hackensack Meadowlands in New Jersey. The spill, which occurred in 1973, originated from a truck parked behind its company offices for the weekend. The Coast Guard claims it recovered 1,400 gallons of the chemical, allowing only 100 gallons to reach the Hackensack River.

- In 1974, in Cape May County, New Jersey, an underground tank containing approximately 10,000 gallons of cresol and cresite wastes was discovered during the construction of an elevator shaft for a housing project. The wastes had been stored by a gas manufacturing plant that went out of business in the early 1960's. It is believed that the wastes would eventually have polluted local beaches had the tank not been discovered. The wastes were pumped out and destroyed by incineration.

- In 1960, in Aurora, Illinois, well installations were abandoned and a new water supply developed from an unaffected source at a laundry, when a leaking fuel oil tank adjacent to the establishment polluted its water supply wells. During the fall of 1967, one of the supply wells was reactivated to determine the present chemical quality of the groundwater. A strong hydrocarbon odor and taste still was apparent in the well water after more than seven years.

J.5 Disposal Incidents

- Improper disposal of excess herbicide in a hand pressure sprayer was responsible for the death of a two year old female and the illness of two other children in January 1967, near Abilene, Texas. The herbicide, containing 34.3 percent monosodium methanearsonate, was used to control weeds in a garden area adjacent to the farmstead. When spraying was completed, the sprayer was dumped next to a shed, a location accessible to children. The two year old consumed a lethal dose of the spray. The two other children ingested enough to result in hospitalization.

- In October 1974, a bulldozer operator was killed in an explosion at an industrial landfill in Edison Township, New Jersey, as he was burying and compacting several 55-gallon drums of unidentified chemical wastes. The victim died as a result of burns, which covered approximately 85 percent of his body.

- A load of acidic aluminum sulfate was inadvertently discharged into an excavation containing sulfate waste. Hydrogen sulfide was released and the truck driver disposing the acidic aluminum died in his cab at the landfill site.

- A landfill operator died from second and third degree burns when the compactor he was operating struck a 55-gallon drum of ethyl acetate. The incident occurred after a scavenger/hauler had deposited a load in the dark hours of the morning.

- Improper disposal of a barrel formerly containing concentrations of parathion resulted in the death of a man in McAdoo, Texas, in October 1968. After using an acetylene torch to cut the top off the barrel, he experienced dizziness and loss of sight. He died soon afterwards in the hospital. The doctor diagnosed the death as respiratory paralysis due to accidental parathion poisoning.

- In June 1972, two male children, aged five and six years, were admitted to a Batesville, Mississippi, hospital with symptoms of severe organic phosphate poisoning. The following day, a seven year old child from the same family was also admitted. On the same day, an 11 month old female died at the same home. The other three children recovered and were released from the hospital. They evidently ate some soil in their back yard where the mother had poured methyl parathion ten days earlier.

- A Chicago landfill employee was killed when a 55-gallon drum of ethyl acetate exploded, causing an intense fire. The contents of the drum were under some pressure after having been exposed to sunlight. The caterpillar operator received third degree burns over 30 percent of his body, second degree burns over 70 percent of his body, and inhaled super heated air. He survived only three days.

- Injuries and illnesses resulting from on-the-job accidents at one landfill are under investigation by OSHA. It is suspected that chronic health problems exist among employees at all industrial dumps. At this particular dump, one man had to quit his job because of alleged lead poisoning. Upon examination of the log of all occupational injuries and illnesses that occurred at this landfill in the first ten months of 1974, seven incidents were listed:

  1) Bulldozer operator killed by explosion and fire resulting from the burying and compacting of unknown chemical wastes;

  2) Eye irritation sustained while bulldozer operator was pushing drum which split, squirting liquid into his eyes;

  3) Smoke inhalation which caused respiratory and stomach conditions while operator was fighting a fire on a bulldozer;

  4) Chemical burns to hands and other parts of body as a result of pushing a drum with a bulldozer. The drum split open and liquid squirted out;

  5) Conjunctivitis caused by fumes from waste products although safety glasses were being worn at the time of injury;

  6) Burned foot when driver stepped out of his truck into a hole containing 250 F acid waste;

7) Sustained burn of the cornea while dumping acid from a tank truck.

- An employee of a county landfill in Minnesota was seriously burned when a piece of equipment he was operating crushed and ignited a container of flammable solvent which had been illegally deposited in the landfill. The employee suffered burns over 85 percent of his body and was hospitalized in intensive care for four and one-half months.

- An employee of a private dump in Cincinnati, Ohio, was burned over 50 percent of his body when several containers of an unknown volatile liquid caught fire and enveloped his bulldozer. Firemen had to run their hoses more than a half mile to get to the fire because the dump had no hydrants.

- Two Belmont, California, firemen who inhaled a deadly rat fumigant in 1973 have since retired with permanent disabilities. Eight other firemen are still being treated for exposure to the deadly fumes. The gas, a mixture of methyl bromide and chloropicrin, came from a 300 pound canister that was abandoned by a pesticide manufacturer, then stored outside a motorcycle shop until the owner could make a "standup fireplace" from it. Before the owner could do so, however, fumes began pouring from the canister as the man opened a cap on the top of the canister. At least '8 persons, including seven firemen, were hospitalized after inhaling the fumes. Among the effects of the gas incident are permanent lung damage to two individuals and possible brain damage to another. In October of 1974, 21 persons who claimed they suffered from the incident filed a $2.3 million suit against the manufacturer who makes the fumigant.

- Members of a farm family, Winnebago County, Illinois, apparently suffered mercury poisoning as a result of illegal dumping of industrial wastes. A teenage son in the family has incurred brain damage; other family members have suffered other symptoms; cattle on their farm have been stricken and in one case, death occurred. The farm adjoins an abandoned quarry formerly used by a private contractor for dumping barrels of waste from a chemical company in Rockford, Illinois. The wastes included phenol, paint solvents, and resins. Tests have established that during heavy rains, leakage from both above-ground storage and from dumping in the quarry contaminated a 40 foot well and a 200 foot well on the farm. The youngest boy in the family has suffered prolonged headaches, pain in the heels of his feet, pain in his ears, chronic tonsilitis, nervousness. The farm was rendered unsuitable for livestock raising since the tainted water apparently rendered the cows and hogs sterile.

- A seven year old female who had experienced nausea and vomiting the previous evening was admitted to a North Carolina hospital in a comatose state, suffering from organic phosphate poisoning. After a restless evening, she lost her ability to walk, complained of difficulty seeing, and became progressively unresponsive. An immediate inspection of her home revealed a discarded five-gallon drum of pesticide collecting rainwater in the back yard. Neighborhood children reported that the little girl had filled a plastic spray bottle with the contaminated rainwater, and sprayed some of it in her mouth while making mudpies. The girl rapidly responded to treatment, recovering completely.

- In 1972, a two year old boy in Hughes, Arkansas, was hospitalized for organophosphate poisoning after playing among some empty drums formerly containing various pesticides. The drums were procured from a aerial applicator to serve as trash containers. The child completely recovered from the poisoning after medical treatment.

- Two brothers, aged one and two years, were brought to a North Carolina hospital with sudden onset of vomiting, diarrhea, and difficult breathing. Increased salivation and pinpoint pupils led their doctor to suspect organic phosphate poisoning, and treatment for that was successful. The boys' father reported that on the afternoon the boys had become ill, they had been jumping in and out of an empty 209 liter drum that had recently held organophosphate pesticide. Sufficient residue remained in the drums to cause poisoning from dermal absorption.

- Wastes in metal drums were disposed at a landfill in York County, New York, which has no permit for hazardous wastes disposal. An EPA regional inspector stepped into a trench to investigate the drums, when a lye substance splashed on his skin, requiring medical treatment.

- Between 1947 and 1952, a chemical company in Niagara Falls, New York, used Love Canal as an industrial toxic waste dump. Thousands of drums were dropped directly into the receding water of Love Canal or buried in its banks. In 1953, the land containing the canal was sold and a school and homes built on the site. In 1976, after six years of abnormally heavy rains, the canal overflowed its underground banks and at least 82 different compounds, 11 of them suspected carcinogens, began percolating upward through the soil into the back yards and basements of the homes and school along the canal site.

Children and dogs have been burned playing in the fields, visitors have had the soles of their shoes corroded through, and some backyard trees have been completely gnawed away by chemical action. Air monitors placed by the U.S. Environmental Protection Agency in the basements of some homes have counted levels of from 250 to 5,000 times as high as is safe for some chemicals. Large numbers of miscarriages (a miscarriage rate rate of 29.4%) and birth defects have been reported for area residents. Local residents have also indicated that many in the neighborhood have died of rectal, blood, and breast cancer, and the New York State Health Department is planning to make a study to verify these reports.

- At a sanitary landfill near Dundalk, Maryland, a 2,000-gallon liquid industrial waste load containing iron sulfide, sodium sulfide, sodium carbonate, and sodium thiosulfate, along with smaller quantities of organic compounds, was discharged into a depression on top of an earth covered area of the fill. When it reached eight to ten feet below the point of discharge, the liquid started to bubble and fume blue smoke. The smoke quickly engulfed the truck driver and disabled him. Several nearby workers rushed to his aid and were also disabled. During the clean-up operation, one of the county firefighters collapsed. All six of the injured were hospitalized and treated for hydrogen sulfide poisoning. It was not determined whether the generation of gas was due to the instability of the waste or the incompatability of the waste with some of the landfill material.

- Six men, one of them a Baltimore firefighter, were hospitalized in 1975 after inhaling noxious hydrogen sulfide gas at a landfill near Baltimore, Maryland. The accident occurred when the driver was unloading 2,000 gallons of liquid sodium sulfite and suddenly became faint. Others rushing to his aid were also overcome by the fumes emitted from the liquid. When the alkaline waste was discharged, it apparently contacted some substance already on the ground and reacted with it to form hydrogen sulfide.

- For two days in June, 1968, a farm worker, his wife, and three children experienced abnormal pain and vomiting from drinking contaminated well water at a vegetable farm in Neshanic Station, New Jersey. The water was characterized by the family as greasy, with a kerosene-like taste. It was found to be contaminated with oil-born insecticide arising from the disposal of an empty pesticide container in the well area. The family was treated at a hospital and released.

- In Texas, barrels containing chemical wastes were caught in shrimpers' nets in the Gulf of Mexico. Physical damage to nets and equipment occcurred, and exposed shrimper crewmen experienced skin burns and eye irritation.

- In 1973, a truck driver in Richmond, California, developed conjunctivitis blephaxitis when posdrin dust got into his eyes while throwing bags of insecticide into a dump.

- For years, a chemical packing plant practiced open dumping of its waste products on its property and experienced a number of leaks and spills of industrial chemicals. As a result of these poor maintenance practices, diethyl ether entered the water table and adversely affected several nearby water wells in 1973. One well had concentrations of diethyl ether as high as 44 mg/l. Despite several attempts at correction of the pollution, several families reported a disagreeable flavor to their well water, while one family reported illness from use of their well water. Another family, whose well showed 75 ppm diethyl ether, was connected to the company water line to relieve the problem. Many of the affected wells apparently cleared spontaneously.

- A landfill in south Jersey was apparently the cause of groundwater pollution from cyanide and phenol leachate. An area resident complained for over a year that her water had an odor, stings the skin, and has caused bladder infections. The New Jersey Environmental Protection Agency performed some initial sampling in 1974 and found that cyanides and phenols were two and twenty-one times respectively, the recommended drinking water standards.

- Residents of Crosby, Texas, were subjected to sore throats, nausea, and headaches after local wells were contaminated from a reaction between oily wastes and acids which had been dumped in an abandoned sand pit.

- In Franklin County, North Carolina, 22 Angus cattle died when they ingested calcium arsenate that had been discarded 20 years earlier in a trash pile at the farm.

- In 1969, eleven pigs died in Patterson, Louisiana, after eating Aldrin-treated seed rice which had been haphazardly dumped on the head land in a rice field. The swine owner observed the pigs coming out of a cane field runnnng and having convulsions. Analysis of rumen contents showed 230.7 ppm Aldrin and 1.13 ppm Dieldrin.

- Eight Angus cattle died of arsenic poisoning in Elizabeth City, North Carolina, after eating residual ashes from the incineration of old bags and plastic cans formerly containing pesticides.

- Four swine died from mercury poisoning near Quachita County, Louisiana, after eating treated seed corn obtained from a city dump. A veterinarian reported that several people had taken corn from the dump, although no other illnesses were reported. A tag near the disposed corn read 80 percent Thiran and 2 percent Malathion.

- In 1974, in Newton County, Iowa, four cattle died and four others adversely affected when they broke through a fence surrounding a junk pile where a bag of lindane was dumped. Lab analysis of the rumen contents of the dead animals showed 4,400 ppm lindane.

- According to a veterinarian's report in September, 1971, six or seven cows died from arsenic poisoning, resulting from improper disposal of a cotton defoliant in a Texas City landfill. Approximately 100 boxes, each containing 4 "empty" plastic containers holding a small amount of residual arsenic, had been placed at the landfill by a warehouseman of a chemical company. The grazing cattle had entered the landfill from nearby pasturelands.

- In September 1967, a fisheries biologist for the Texas Parks and Wildlife Fish Hatchery discovered three dead cattle in a dumping pit which also contained empty insecticide cans in Hays County, Texas. Poisoning is the suspected cause of the deaths.

- In Byron, Illinois, unregulated land disposal of cyanides, heavy metals, petroleum products, and acids resulted in extensive environmental and property damage. The dumping of industrial wastes at a farm site was begun two years previously, but it was not until three dead cattle had been found, numerous wildlife kills had occurred, and local vegetation had been killed, that the city decided to halt dumping at the site.

- At a farm site in Illinois used for dumping of highly toxic industrial wastes, mostly from metal finishing processes, three cows died as a result of cyanide poisoning, and extensive damage occurred to wildlife, aquatic biota, and vegetation. Crops cannot be safely grown in the area.

- In 1974, an investigation, sparked by the deaths of three cows near Byron, Illinois, revealed an abandoned disposal area for many industrial wastes, including cyanides, arsenic, cadmium, chromium, petroleum products, acids, and other wastes. Soil, surface water, and groundwater contamination, along with extensive damage to wildlife, aquatic life, and local vegetation, were documented. U. S. drinking water standards were violated by at least 5 constituents in surface water entering Rock Creek one and one-half miles from the site: arsenic, 60 ppb; cadmium, 340 ppb; Chromium, 17,200 ppb; cyanide, 365,000 ppb; and phenols, 8 ppb.

- In Haywood County, Texas, approximately 24 drums of concentrated dyes and other chemical liquids were illegally dumped at a landfill. The toxic liquids were washed downstream, poisoning three cows fatally and rendering many others ill.

- Two cattle died and three others were affected from licking one partially filled and several empty bags of dyfonate left in a pasture for burning. The bags and excess pesticide were buried following the poisoning which occurred in Cedar County, Iowa, in 1974.

- The death of a Holstein calf in 1975, in North Carolina, is believed to have resulted from the owner's land disposal of old pesticides, some of which contained arsenic.

- A battery manufacturing plant in Berks County, Pennsylvania, caused stream contamination as a result of the surface disposal of old battery casings. Acid and lead-bearing leachate originated at the disposal site and from numerous spills at the plant, which has been in operation for twenty years. Almost all aquatic life in the stream was destroyed by the pollution.

- In March 1972, a considerable amount of xylene was dumped into a drainage ditch along the Pennsylvania Turnpike. The liquid waste flowed down the ditch, across a field, and into a nearby stream, causing a fish kill.

- In July 1971, a fish kill involving more than 500 fish was reported in Bear Swamp Creek in Duplin County, North Carolina. The fish kill was confined to a small area, where broken tobacco spray jugs, dumped trash, fertilizer containers, and household trash were found. Upon water analysis, endosulfan, an odorless crystalline insecticidal agent contained in the tobacco spray, was found in concentrations much greater than what are considered to be toxic levels. The insecticide, along with the relatively low dissolved-oxygen content of the water, was probably the immediate cause of fish mortality.

- Sludge wastes from a chain and cable company were included in the industrial wastes disposed at a Pennsylvania landfill until 1975, when the State halted the disposal due to the high zinc and copper content of the sludge. The sludge is believed to have caused fish kills in the creek in the past.

- In 1967, in Pennington County, South Dakota, acids and other chemicals were discharged as waste from mineral refining plants. As a result, an aquifer recharge zone was contaminated and aquatic life in an adjacent stream was killed.

- In 1954 in Adams County, Colorado, infiltration of industrial wastes from earthen disposal reservoirs occurred on arsenal grounds into the aquifer. A highly saline groundwater body (about 10,600 mg/l dissolved solids, 5,700 mg/l chloride) formed beneath pits. Severe crop damage resulted when contaminated groundwater was used for irrigation. Effects were similar to those of 2, 4 dichloro phenoxy-acetic acid, a plant toxicant. Area of contamination includes about five square miles of the South Platte River valley immediately northwest of the arsenal property.

- During compacting operations at a Delaware County, Pennsylvania, landfill, an explosion occurred that destroyed a bulldozer and caused a fire that burned for several days. Groundwater contamination resulted from firefighting activities, causing a fish kill in Crum Creek in 1972.

- Hundreds of empty 55-gallon containers and dozens of 50-pound bags of DDT, sevin, malathion, and parathion were left behind when a pesticide formulator went bankrupt. On a loading platform to the rear of the warehouse was a palette with about 50 boxes stacked on it, each containing 12 one-pint bottles of concentrated parathion. Many of the bottles were broken and many had the tops rusted through. In the immediate vicinity were two dead rattlesnakes and numerous dead birds.

- Migration of gases from a landfill containing household and industrial wastes, along with sewage sludge, resulted in the deaths of over 70 peach trees in Glassboro, New Jersey, between 1971 and 1975. Combustible gases and carbon monoxide were found, along with low oxygen concentrations, in the root zones of the trees up to 24 meters (80 feet) from the landfill.

- In 1972, discharge of an unidentified acidic and hazardous chemical from a factory designed to recover silver from photographic material was reported in burned vegetation along the path of the discharge.

- Open dumping of oil, paint, and water wastes at a poorly operated lagoon in Herrin, Illinois, killed an extensive amount of vegetation by runoff into smokeholes.

- In Louisiana, hexachlorobenzene (HCB), a toxic industrial by-product, was dumped in a rural landfill where it sublimated. Cattle absorbed HCB in their tissues and 20,000 animals were quarantined by the State Department of Agriculture.

- Death of vegetation in the vicinity of landfill sites has been attributed to anaerobic biodegradation of organic wastes resulting in high soil levels of methane and carbon dioxide that are directly toxic to roots or that remove oxygen from the root zone. About 30 percent of 471 landfill sites surveyed exhibited vegetative growth problems that may be attributable to this cause.

- While burying drums containing an unknown waste, a bulldozer operator at a Michigan landfill experienced dizziness and eye irritation, and soon left his bulldozer. Upon returning, he found the machine in flames. Evidently, some of the drums contained volatile flammable substances that ignited while he was gone.

- In early 1974, approximately 1,000 gallons of petroleum-based cleaning fluids were poured into a landfill in Haywood County, North Carolina. The disposed fluids overflowed the top of a dike and entered a tributary of Hominy Creek. Three cattle that drank from the contaminated stream were fatally poisoned. The source of the fluids was a textile dying company. The town of Catton compensated the cattle owner for his losses, and the stream waters were decontaminated.

- A chemical company in Providence, Maryland, dumped chemical solvent wastes at a quarry between 1960 and 1974, often leaving the chemicals open in an evaporating pool before covering them up. Among the solvents dumped were benzene, which is known to damage blood-forming organs and to cause leukemia; carbon tetrachloride; acetone; ketones; methylene chloride; and others, many of which were found in abnormal amounts in the air in the area. Most solvents handled by the company can cause damage to the liver, kidneys, pancreas, and the central nervous system, and most are deadly in high concentrations.

  Residents in the quarry area, as well as some company employees, chronically complained of the classic symptoms of chemical fume exposure: headache, nausea and vomiting, chronic fatigue, weight loss, memory loss, etc. One doctor found that seven out of eight residents he had examined had abnormalities of the liver and/or pancreatic functions. Carbon tetrachloride was found in employees' blood. Carbon tetrachloride is highly toxic to the liver and kidneys and is normally not found in the blood. Cancer deaths from lymphoma malignancies occurred among company employees in the quarry area --44 times higher than the national incidence. The death rate was 2.2 times greater than the rest of the county; and the death rate due to cancer was seven times greater than that for the county. The victims usually lived just meters away from the chemical plant.

  The company was ordered to cease dumping at the quarry in 1974, and by 1975, had removed most of the wastes from the quarry to be dumped at a landfill in New Jersey.

- Mason and Issa Creeks in King County, Washington, have been severely degraded by leachate from a dump which accepted for three years industrial and hospital wastes in addition to municipal refuse. The creeks have developed high concentrations of iron and zinc and have fostered the growth of a slime mold which has been killing salmon eggs and fry at the Issaquah State Fish Hatchery, with estimated losses of $280,000 since 1973.

- During a five day period in 1968, more than 500,000 fish were killed in the Watauga arm of the Boone Reservoir in North Carolina. During an investigation, many 55-gallon steel drums were noted floating loose in the reservoir and stranded along the shorelines. Several contained one or more gallons of toxic chemicals, including phenylmercuric acetate and trichlorophenol. Further studies confirmed that the contents of the drums, which were produced by a chemical and petroleum company and emptied for flotation, were responsible for the kills.

- In 1970, an applicator rinsed and cleaned a truck rig after dumping unused Endrin into the Cuivre River at Moscoe Mills, Missouri. This resulted in the killing of an estimated 100,000 fish in the river, closing it to fishing for one year.

- In 1970, neutralized spent pickling liquors dumped in an abandoned strip mine by a waste disposal firm leached into the surrounding soil and eventually into streams in Monroe County, Ohio. Fish were killed as a result in nearby Wilson's Pond. In 1971, Wilson's Pond overflowed into Little Beaver Creek, causing a major kill of some 77,000 fish. The disposal firm was ordered to construct facilities to contain and treat wastes which were being discharged into a nearby stream. Extensive pollution of groundwater persists, however, and is a threat to the water supply of several homes and a school.

- An estimated 12,600 fish were killed in Rockfish Creek and the Northeast Cape Fear River when a North Carolina company disposed leftover endrin from a previous pesticide business down a storm sewer into a holding ditch. The company became aware of the fish kill, and agreed to compensate financially for the fish lost and the cost of investigating.

- Occasional mismanagement of spray irrigation fields in Wilson, North Carolina, has caused pollution and subsequent fish kills within Contentnea Creek and Harmony Swamp. On at least two occasions, runoff of the company's caustic wastes from the spray irrigating fields has killed several thousand fish.

- In 1971, in Knoxville, Tennessee, leachate from an active landfill site located in a large sinkhole threatened aquatic life and recreational use of a small lake in a residential area.

- Beech Creek near Waynesboro, Tennessee, has been severely degraded for at least 10 miles downstream from the city dump. Between 1970 and 1972, the dump received waste PCB's that were off-loaded into a spring which feeds the creek. Numerous fish and local wildlife which watered in the stream have been killed, and all beneficial uses of the stream (watering stock, fishing, drinking water supply, and recreation) have been lost.

- PCB wastes deposited at a city dump in Tennessee were pushed into a tributary of Bear Creek and resulted in mortality of fish, shellfish and mammals. Ten miles of stream were impacted.

- In June 1971, an entire fish population was destroyed after one and one-half pounds of endrin solution mixed with strychnine-treated corn, in a plastic container, was thrown into Shawnee Lake in Ohio. Endrin concentration in the lake was about 9 ppb after the incident; endrin is poisonous to fish at concentrations as low as 0.2 ppb. The only surviving aquatic vertebrates were tadpoles, which appeared to be unaffected by the pesticides. The endrin was completely removed from the lake water by filtering through a column of activated charcoal.

- Average PCB levels in upper Mississippi River fish species ranged from 0.04 to 3.97 ppm, with the highest levels occurring in fish having high fat content (e.g., bass, carp, channel catfish). Large numbers of young ranch mink were killed due to consumption of contaminated carp. Likely sources of PCB to consumption of contamination included industrial waste and leachate from sanitary landfills.

- Numerous leaks, spills, and dumps of nitrogenous materials by a company in Cattaraugus County, New York, have caused contamination of the aquifer under and adjacent to the plant. At least two massive fish kills have taken place in the Allegheny River that can be attributed to the nitrogenous compound pumped as cooling water from an aquifer to Two Mile Creek, flowing to the Allegheny River. Wells drilled there in 1970 contained 70-90 ppm nitrates. At least 20 domestic wells had nitrate levels treater than 100 ppm and were suitable for drinking.

- In April 1975, an employee in York County, Pennsylvania, siphoned water from a company's settling pond into a storm drain emptying into Fishing Creek. The acidity of the drained wastes caused a fish kill in the creek. The waste and sludge in the ponds were spent pickle liquors which had allegedly been neutralized. The sludge is to be hauled to a landfill and the lagoons are to be lined.

- Since 1939, electroplating industries in Bronson, Michigan, have experienced difficulty in disposing electroplating wastes. Originally, the wastes were discharged into the city's sewer systems that emptied into a creek. Contamination of this water resulted in the death of fish and cattle below Bronson from cyanide poisoning. All the plating wastes of the company were subsequently discharged to ponds.

In 1942, it was found that the dikes around the ponds were unsafe, and the sewer system had again become contaminated by chromates. The chromium probably resulted from the leakage of water from the ponds both above and below ground, or from the use of the sewer system for waste disposal. Subsequent cases of surface water contamination were reported.

- Uncontrolled release of ammonia-containing waste and some metals by a manufacturer in Middleport, New York, resulted in a massive fish kill at a time of low flow in Jeddo Creek.

- In 1970, in LaVerne, Rutherford County, Tennessee, fluoride-rich leachate from fertilizer-tailings piles had allegedly infiltrated the water table and migrated through bedrock openings to points of discharge in Hurricane Creek. Fish kills have occurred in Hurricane Creek as a result of high concentrations of fluoride believed to be entering the stream as groundwater inflow.

- Residents near Joliet, Illinois, complained of a red discharge into Des Plaines River in February, 1974. Extremely high BOD, COD, iron, manganese, and other heavy metals levels were found. The source of the pollution was a chemical company which dumped power and crystalline chemicals into 30-gallon rust-away drums and disposed them in lagoons. Two acres of vegetation were destroyed.

- Leachate from an abandoned landfill receiving industrial wastes killed all forms of life in a two mile stretch of the Little Manitowac River in Wisconsin.

- A chemical company disposed of unidentified solid chemical wastes in a landfill on their property for a number of years in Will County, Illinois. In February 1974, area residents complained of a reddish discharge into the Des Plaines River from a tributary stream which drained off the company property. Monitoring tests on the runoff from the site taken at the stream showed iron, 2,600 ppm; manganese, 1,360 ppm, nickel, 2.4 ppm, and sulfates, 2,200 ppm. The runoff destroyed several acres of vegetation downslope from the disposal site.

- Runoff from quenching a fire at a landfill in Murfreesboro, Tennessee, caused turbidity and mild contamination of wells in the area. Zinc and chromium electroplating waste sludge, as well as industrial phenols, were disposed at the site, along with demolition waste and municipal refuse. Consequently, the site was closed by the city, and the municipal water line was extended into the affected area.

- Extensive sediment pollution of a Wayne County, Tennessee, creek resulted from leachate of industrial wastes disposed at a local dump. The dump was used for a number of years to dispose of wastes consisting of polychlorinated biphenyls, tri-chloroethylene, and cutting oils. Measurable amounts of polychlorinated biphenyls were also found in several wells in the area.

- Between 1962 and 1972 in Lawrenceburg, Tennessee, an industry dumped up to 5,000 gallons of untreated metal plating waste daily into trenches near the city dump. Significant concentrations of hexavalent chromium and traces of cyanide were measured in an adjacent stream used by several local residents as a drinking water supply.

- For several years, a Tennessee chemical company buried highly toxic pesticide wastes at a dump in shallow unlined trenches, at the rate of about one hundred steel drums per week. The containerized chlorinated hydrocarbon wastes gradually escaped into the subsurface environment, contaminating not only the groundwater, but also a nearby creek.

- A landfill in Hamblen County, Tennessee accepting municipal refuse and pesticide wastes was closed in 1975 after leachate from the landfill polluted wells and springs in the area.

- In 1958 in Marathon County, Wisconsin, papermill waste disposed in infiltration ponds entered the aquifer and gravitated to the bedrock valley. The slow down-valley movement of sulfite liquor threatened the water supply of several industries and a city.

- Over a 50 year period, waste chemicals such as phenols, tetraethyl lead, radioactive wastes, and explosives were disposed in unlined lagoons, landfills, and ditches in Salem County, New Jersey. Groundwater and some private wells around a 40 acre site were contaminated.

- The Coast Guard has detected oil and chemical pollution in New Jersey Coastal waters near Newark. Leachate from a landfill in Newark as well as another landfill has been blamed for the contamination. Dumping has occurred at the landfill site since 1967. A large-scale oil cleanup conducted by the Coast Guard recovered approximately 500,000 gallons of oil.

- Approximately 60,000 gallons of chemical liquid wastes were dumped on the ground at a landfill in Middletown Township, New Jersey, in April 1973. The spillage resulted in the contamination of Diaz Creek by many chemical wastes, including solvents and hydrocarbons. A lake was fouled for about one and one-half miles from the dump site as was drinking water in the adjacent area.

- Leachate from a dump in Elkhart, Indiana, was suspected of contaminating at least six nearby domestic wells with pharmaceutical and possibly electroplating and other industrial wastes. Pollution was first detected in April, 1973, when the homeowners complained of their water becoming "foul." Subsequent testing confirmed that the water was unfit for drinking due to high chemical oxygen demand, sulfates 350 ppm, and chromium 6.0 ppm. A shallow groundwater aquifer was contaminated in the immediate vicinity of the dump. However, the source of pollution was never legally determined.

- Groundwater contamination from gasoline in Texas County, Texas, was the result of leakage, spillage, and discharge of automotive fuels onto the land surface.

- Following heavy rains in January 1969, 37 fifty-five gallon drums, some leaking, containing a mixture of phosphoryl chloride, phosphorous oxychloride, and thinonyl chloride were found along the San Gorgonio River channel. Seventy five of the drums had been buried in a dump upstream four years earlier. The chemicals in the drums unearthed by the flood were highly toxic liquids used in the manufacture of Parathion, an organophosphate pesticide. Further investigation disclosed that the chemical company generating the wastes had contracted a commercial waste disposal firm in 1965 to dump the material into the Pacific Ocean. No known poisonings resulted from the incident following the flood.

- Since 1972, sludge from two wastewater treatment plants has been accepted at an open land disposal site that had been in operation for 15 years by the city of Saco, Maine. Sludge from one of the treatment plants contains 90 percent by volume tannery wastes. Since 1973, large quantities of sludge from the primary wastewater facility at the tannery have been sent to the dump. A complaint by adjacent property owners in 1974 prompted testing. Tests showed contamination of groundwater supply by high levels of iron (44-2000 mg/l) and manganese (4-230 mg/l), as well as traces of chromium. The surface water of the adjacent property has been contaminated to an unknown extent.

- Deteriorating chemical drums buried in Berkeley, New Jersey, that were considered potentially explosive by the state could cause relocation of a major sewer interceptor line. Wastes have leached into groundwater from 825 drums of waste sodium and from 15,000 drums of organic waste material from a cosmetic firm.

- In Washington County, Pennsylvania, leachate from a landfill has entered the groundwater and has contaminated a farmer's well and spring a half mile away. The landfill accepted sludges containing heavy metals and poorly neutralized pickle liquor from steel mills.

- An aircraft plant, operating in South Farmingdale on Long Island during World War II, generated large quantities of electroplating wastes containing chromium, cadmium, and other metals. It has been estimated that 200,000 to 300,000 gallons per day of these wastes were discharged into unlined disposal basins throughout the 1940's. A treatment unit for chromium was built in 1949, but discharge of cadmium and other metals continued. The local groundwater flows in three unconsolidated aquifers resting on crystalline bedrock. The uppermost aquifer consists of beds and lenses of fine-to-coarse sand and gravel and extends to within 15 feet of the land surface. Groundwater contamination by chromium was first noted in 1942 by the Nassau County Department of Health. Extensive studies in 1962 indicated that a huge plume of contaminated groundwater had been formed, measuring up to 4300 feet long, 1000 feet wide, and extending from the surface of the water table to depths of 50-70 feet below the land surface. Maximum concentrations of both hexavalent chromium and cadmium were about 10 mg/l in 1962. (Hexavalent chromium had been measured as high as 40 mg/l in 1949.) This huge contaminated plume cannot be removed or detoxified without massive efforts and will take many more years of natural attentuation and dilution before it becomes usable again. Meanwhile, it is still slowly moving, threatening a nearby creek and other wells in the area.

- Public drinking water of Falls City, Texas, was threatened when toxic wastes were disposed in a caliche pit upstream from the city's water supply by a chemical company. The chemical wastes included styrene tantalum vinyl chlorides which federal sources have found to be linked with a rare form of liver cancer. The pit is littered with large drums whose contents have produced a scum coat on the pond in the bottom of the pit.

- Industrial wastes disposed in a landfill in Lehigh County, Pennsylvania, contaminated a well of the West Ormrod Water Association with excessive phenols, including ethyl acetate and trichloroethylene. The landfill is within an abandoned ore pit and has been receiving trash and industrial wastes since 1967. Although liquid waste disposal there ceased in 1970, contamination continues to render the water supply to numerous homes unusable.

- As early as 1968, a firm in Houston, Texas, was made aware that its practice of discharging such hazardous wastes as cyanide, phenols, sulfides, and ammonia into the Houston Ship Channel was creating severe environmental debilitation. The toxic wastes in question were derived from the cleaning of bast furnace gas from coke plants. According to expert testimony, levels as low as 0.05 mg/l of cyanide effluent are lethal to shrimp and small fish. The court ordered the firm to cease discharging these wastes into the ship channel.

- Arsenic wastes from pharmaceutical manufacturing were discharged into sludge lagoons in Pennsylvania prior to 1966, contaminating the groundwater, and in turn, Tulpehocken Creek upstream of an intake for Philadelphia's water supply. Despite persistent pumping of the groundwater in an attempt to flush the arsenic out of the aquifer, the creek water still contained 0.094 ppm arsenic in 1975, exceeding the U.S. interim primary drinking water standards of 0.05 ppm, significantly higher than 0.01 ppm measured upstream. In addition, arsenic is seeping into the Meyerstown municipal sewer lines and entering the treatment plant, which now requires upgrading in order to reduce the arsenic to acceptable levels.

- A landfill in Monroe County, Pennsylvania, that accepts plating process wastes such as hydrocyanic acid, has created a groundwater problem in the area.

- Volatile liquid organic wastes from a chemical manufacturer in Bridgewater, New Jersey, were discharged into subsurface disposal beds in the mid-1960's. The wastes traveled underground for a mile before surfacing to pollute a nearby stream and then seeping into residential basements in 1967. In 1968, the disposal operation was halted and the remaining wastes in disposal beds were hauled away.

- A landfill in Egg Harbor, New Jersey, accepted large quantities of organic and inorganic industrial wastes. In 1973, tabulated analysis of groundwater showed lead concentrations up to 18 ppm. The landfill was ordered not to accept any more chemical wastes.

- In Harris County, Texas, a chemical company that produces insecticides, herbicides, and similar products containing arsenic, has been involved in litigation over the discharge of its waste onto the land and adjacent waters. Charges indicate that the manufacturer was discharging waste containing excessive arsenic into Vince Bayou, which produces arsenic-laden water drainage into public waters. The practice of dumping waste solids containing arsenic into open pits and ditches on company property was abandoned in 1967 in favor of a recycling process.

- Over the past 50 years, sludge and asbestos wastes have been dumped in an Ambler County quarry. The pH is high in the quarry waters, and some asbestos fibers have been discovered in the water. Some surface and groundwater contamination has also occurred.

- Industrial and municipal wastes disposed in a landfill in Dauphin County, Pennsylvania, have resulted in leachate contamination of groundwater and of Spring Creek. The industrial wastes accepted before the site closed in 1975 included paper, wood, oil waste, and other dry materials. Water supplies from monitoring wells at the landfill revealed excessive iron, chlorides, and sulfates.

- A landfill in Jacksonville, Florida, that receives hazardous and chemical waste, has begun to leak oily material into a nearby creek.

- A truck stop in Maryland was responsible for allowing diesel fuel runoff to despoil Marley Creek. The pollution amounted to more than 500,000 ppm of oil that had entered the creek, as well as oil deposited in the sandy soil at the truck stop site. The corporation owning the truck stop was fined $3,400 and was ordered to pay the cost of preventing further pollution of the creek.

- In May 1974, a flood washed between 12,000 and 15,000 drums of unknown waste chemicals into a stream. A foul odor was emitted, but no fish kill followed the incident.

- A disposal company undertook to dispose of some drums containing unidentified toxic residues. Instead of properly disposing of this material, the company dropped the drums at a dump located in Riverside County, California. Later during a heavy flood, the drums were unearthed, giving off poisonous gases and contaminating the water.

- Waste zinc chloride, zinc sulfate, and lead generated by industry in Middlesex County, New Jersey, are responsible for pollution of the Old Bridge aquifer in the area. Apparently, the wastes have been dumped in the open and are partially swept away by rainfall into a nearby stream. One stream bottom analyzed for the heavy metals revealed 600 ppm lead and 3000 ppm zinc. The Perth Amboy section of the aquifer and wells adjacent to surface streams in the area have been closed, and it is feared that waters downstream may eventually be affected by the pollution.

- A large landfill operated in New Castle County, Delaware, between 1960 and 1968, received industrial wastes of unknown character and origin in addition to residential and commercial wastes. The wastes were placed in an abandoned sand quarry underlain in part by a thin layer of sandy clay which separated it from the unconsolidated Potomac Aquifer, a major source of water supply for the area. The clay layer was absent beneath part of the site and some of the clay was excavated for cover material at the landfill. Groundwater contamination was first noted in 1972 in a well 800 feet from the fill. The resulting investigation uncovered a large plume of contaminated groundwater moving towards a well field producing 4 to 5 million gallons per day (mgd) and located about 5000 feet from the fill. A computer pumping operation now removes 3 mgd from the aquifer; the well field is pumping at a reduced rate of 2 mgd and the deficit is made up by other sources at the County's expense. Presently a dozen wells are pumping contaminated water to create a cone of depression near the site and 35 wells are monitored monthly. So far, expenses have reached $800,000 for monitoring, pumping, and replacing water supplies. It is expected that it will cost more than $20 million if the dump must be moved, and that it will require 10 years to restore full usage of the aquifer.

- Approximately 60,000 gallons of chemical liquid wastes were spilled on the ground at a landfill in Cape May County, New Jersey, in 1973. The spillage resulted in the contamination of Diaz Creek by numerous chemical wastes, including solvents and hydrocarbons. A nearby lake was fouled for about one mile from the dump site, as was drinking water in the adjacent area. A successful cleanup operation was completed.

- Four private wells in Camden County, New Jersey, were contaminated in late 1972 with phenols that had leached from unlined disposal lagoons belonging to a local manufacturer. By 1973, the phenol concentration in one of the wells was 16.4 ppm. The leaky disposal lagoons were lined to prevent further leaching, and a carbon filter was installed to reduce the persistently high phenol concentration of 0.138 in one of the wells.

- For several years, waste from a chemical plant has been placed in a lagoon located in a very permeable sand and gravel deposit in Tuscarawas County, Ohio. Production wells at the chemical plant and private wells on adjacent property are now polluted with chlorinated benzene, which is not a health hazard to humans, but does greatly influence the taste of the water and is a threat to aquatic wildlife. The Ohio Environmental Protection Agency has restricted the quantity of chlorinated benzene which may be disposed in the lagoon.

- A chemical plant which utilizes two infiltration lagoons for waste disposal contaminated a very productive aquifer in the Hamilton County, Ohio, area. Abnormally high values of sodium, potassium, nitrogen, sulfates, and phenols were found. A few of these constituents in several of the contaminated wells exceeded standards for drinking water.

- During the 1940's industrial and public water supply wells in Fairfield, New Jersey, were contaminated with metals originating from electroplating waste disposal lagoons belonging to military manufacturing plants.

- CBS reported that Pleasant Plains, New Jersey, suffered from a contaminated water problem in 1971 when an industry dumped pollutants into a landfill, causing water in nearby wells to be contaminated by leachate. One hundred and forty-eight wells were closed as a consequence of the dumping.

- An aluminum plant in Monroe County, Ohio, has grossly contaminated the groundwater under its site with flourides, high pH, and trace chemicals, causing discoloration of the water. The source of contamination is leachate from a used-tailing pond and used-potline piles. As a remedial measure, the firm is treating the pollution source with acid, and interceptor wells were installed between the source of pollution and their main production well.

- Phenol contamination of groundwater in Antrim County, Michigan, in 1963 resulted from the disposal of charcoal wastes. Michigan Water Resources Commission estimated that the glacial drift aquifer was contaminated in an area three miles long and 1/2 mile wide to a depth of 200 feet.

- An automobile manufacturing company under a contract with a trucking firm that in turn has a subcontract with the owner of a private dump in the New York City area is regularly dumping tank truck quantities of chromium and zinc-containing paint sludge. The dump where the sludge is disposed is in a swampy area, resulting in contamination of the groundwater.

- A hazardous waste disposal company in Utica, Michigan, received, stored, and processed industrial wastes obtained from liquid waste haulers. In May, 1974, oil-contaminated water was discharged from an oil separator into a swamp that drains into the Clinton River. Apparently the wastewater originally came from leaking and spilled drums, which then flowed overland into the oil separator. In addition to oil, the wastewater was found to contain 0.05 ppm CN, 0.06 ppm nickel, 0.43 ppm chromium, 0.6 ppm zinc, and 0.9 ppm Pb. Although the company claimed the contaminants were due to spills by the previous occupants of the site, the EPA branch of the Michigan Department of Natural Resources disagreed and ordered the company to clean up the site.

- In 1975, a residents well in Hudson, New Hampshire, was polluted with a very unpleasant odor and taste; the water turning white clothes brown when washed in it with bleach. A water analysis showed that the water had a very high iron content as well as phenols. It was discovered that at least 100-150 fifty-five gallon drums of pheno-formaldehyde were dumped on land 150 feet from the well. The residents drank the polluted water for eight months before discovering that it had a phenol content of 3 ppm.

- In December 1963, a citizen complained to the Texas Water Pollution Control Board of the disposal of acid in unlined pits by a seed company. The water from two wells owned by the company were affected by leachate from the sulfuric acid, dissolved lint, cotton seed culls, and wastes disposed into unlined surface pits. Analysis of an industrial well owned by the company revealed a low pH and high concentrations of sulfate, calcium and magnesium.

- In Kent County, Michigan, an aquifer used for a municipal water supply was contaminated by chromium leachate from sand and gravel used as a landfill. The landfill had been taken from a former dumping ground for electroplating wastes. The fill material was removed to ameliorate the pollution problem.

- In 1947, wells in Allegan County, Michigan, produced yellow water which contained high levels of chromium. About three years before any contamination appeared, a metal-plating company began discharging chrome-plating wastes into an infiltration pit and the surrounding overflow area. Discharge of plating wastes resulted in contamination of the glacial-drift aquifer. Health Department personnel estimated it would be about six years before the aquifer in the vicinity of the wells would be free of chromate. All private wells in the village of Douglas were condemned.

- In April 1974, a private water well in Bay City, Michigan, became contaminated by trichloroethylene (TCE). The only nearby source of this chemical was a manufacturer which replaced the well with a new one. The company claimed that although it had discharged TCE into the ground in the past, it had not done so since 1968. Nevertheless, in May of 1975, two more wells were reported to be contaminated with TCE (20 mg/l and 3 mg/l respectively). An investigation did not reveal conclusively that the TCE problem was the result of previous dumping, as several empty and full barrels of waste TCE were found on the company premises.

- A chemical manufacturer had maintained an industrial waste dump on their property for over 10 years. This site is 1/8 mile from the Mississippi River. Wastes disposed there include phenols, esters of phenols, and nitrobenzene derivatives. Sulfuric acid and fly ash were also dumped there. Shallow wells and industrial wells in the area between 1972 and 1974 showed from 7.5 ppm phenol to 15 ppm in 1974.

- A city in Illinois operated a landfill in a former sand and gravel pit from 1947 to 1972 that received residential, commercial, and industrial wastes. Leaching of chemicals into the groundwater caused four industrial, four residential, and one public supply well to be contaminated. The industrial wells were abandoned in 1966, the residential wells in 1970, and the public well in 1972. Contaminants found in levels over the USPHS standard were iron 1.8 ppm, manganese 0.71 ppm, total dissolved solids 800 ppm, and total dissolved minerals 525 ppm.

- Washwater discharge into an open caliche pit from a tank truck terminal operated near Midland, Texas, was responsible for the contamination of a private well near three holding ponds. Significant highs in calcium, sodium and chlorine were found in the well water in 1973. The well water also contained abnormally high concentrations of alkyl sulfonate, phosphate, oil and grease. According to the well owners, an oil spill had occurred in a nearby field in the spring of 1972. The oil-saturated material was spread on the floor of the caliche pit, which also received washwater from the tank term operation. An odor resembling "fly-spray" occurred two months later in the wells.

- The disposal of industrial wastes in an unlined sand pit in Crosby, Texas, resulted in the contamination of groundwater, surface water and the atmosphere. Disposal operations at the site began in the mid-1960's, and in 1967 a waste disposal company purchased the pit from its previous owner. All types of industrial wastes from the Houston area were dumped into the pit. Leachate from the pit polluted the groundwater causing contamination of 26 private wells in the area. Contamination included abnormally high concentrations of zinc, lead, manganese, iron, and cadmium. The San Jacinto River was also polluted due to the structural inadequacy of a sand dike. This resulted in damage to fishing and swimming areas. Residents in the area first complained of the pits' offensive odors in 1966, but not until 1973 was any real affirmative action accomplished to resolve the problem.

- From 1961 to 1972, municipal and industrial wastes were disposed at the city of Aurora, Illinois. During the early months of 1966, nearby residents began complaining of odor problems associated with their drinking water. By the summer of 1966, nine wells had been polluted by leachate; seven totally unfit for any kind of use due to excess chlorine, total solids, and biological contaminants. The landfill was the proven source of the pollution and was sued for $54,000.

- Beginning in 1940, an aircraft manufacturer in Nassau County, New York, disposed plating wastes containing cadmium and 40 mg/l hexavalent chromium by dumping it in liquid waste disposal basins on company property. Not until June 1942, did a routine sanitary survey of a nearby private well reveal 0.1 mg/l of chromium. By 1948, levels of chromium as high as 3.5 mg/l were found in wells.

- Phenolic materials from film-manufacture wastes were dumped into a peat bog over a period of 28 years near Binghamton, New York. This disposal contaminated a water table aquifer and rendered an industrial well unusable.

- A landfill in New York, has accepted trash and some industrial wastes since 1947. Leachate has steadily entered the shallow aquifer water supply and formed a plume two miles long. Trace amounts of copper, arsenic, lead, zinc and nitrogen oxide are present, while selenium occurred in some wells in 40 ppb concentration. Zinc is consistently above 30 ppb.

- A landfill in Islip, New York, has operated since 1933 and now contains trash and industrial wastes. The bottom of the landfill intersects the water table, so that measurable quantities of chlorine, iron, manganese, nitrogen oxide, and zinc are present in an extensive plume.

- A picture tube manufacturer uses industrial quantities of hydrofluoric acid. Waste acid dumped into a lagoon which discharged into a nearby stream leached into the groundwater and was detected in 1970 at a well owned by a railroad company. Fluoride was present in 740 ppm concentration and comparable levels were also present in a nearby private well. Both wells had to be abandoned until most of the fluoride could be treated with lime and removed.

- A private well owned by two elderly people was contaminated by 14 ppm hexavelent chromium in April 1976. The chromium came from a flyash disposal site nearby, which also leached chromium into nearby wells.

- State inspections at a zinc products company in 1974 revealed several incidents of environmental pollution. Within the area of a sulfuric acid plant, surface runoff enters an industrial waste drain in several places. The surface is highly contaminated with accumulated residues. Samples from a spring leaving the slag dump of the plant showed 345 ppm zinc, 68 ppm magnesium, 3.9 ppm cobalt, 0.7 ppm iron, and 0.1 ppm lead. Surface runoff and groundwater pollution are suspected.

- During the 1940's industrial and public water supply wells in the vicinity of Fairfield, New Jersey, were contaminated with metals originating from electroplating waste disposal lagoons of military manufacturing plants.

- In New Jersey, after an extensive federal and state investigation, a landfill was cited as the source of underground water pollution which had contaminated the drinking wells of at least four neighboring property owners. Tests conducted by the Environmental Protection Agency and a private laboratory revealed the presence of metallic, organic and inorganic chemical contaminants including selemium, copper, zinc and phenols in the landfill monitoring wells and other private wells in the area.

- A municipal landfill in Juneau County, Wisconsin, accepted battery wastes from a manufacturer. Groundwater and surface water contamination resulted, as well as fires and explosions.

- Early in 1975, a citizen called the Kalamazoo City Police Department to report that a metal plating operation was discharging wastes during rains, after dark and usually on weekends. Police investigation revealed the presence of a stream of dark-colored liquid discharging from the building and flowing across the road into a sewer drain. Samples of the fluid were taken, and the owner was called to halt the discharge. The effluent was found to contain chromic acid typical of plating wastes. It was determined that the fluid discharge had gone from the sewer into the Kalamazoo River.

- An abandoned municipal landfill in Jackson County, Wisconsin, formerly accepted industrial wastes. Leachate contaminated the groundwater, affecting four private wells.

- A food company plant in Rockford, Illinois has four wells on its property serving as sole water source prior to 1966. In 1965 they experienced a degradation in the taste and odor of the water and a drop in the capacity of their wells. Well samples showed a high concentration of total dissolved solids and relatively high iron, plus coliform bacteria in two wells. An adjacent industrial landfill was suspected to be the cause.

- In 1966, an employee cleaning up around a state highway department garage dumped 30 gallons of excess toxaphene, a very toxic pesticide, into the parking lot drain. The drain entered a ditch which led to a public water supply reservoir serving Effingham, Illinois. Quick action by authorities prevented contamination of the water supply: all of the contaminated gravel and soil in the parking lot drain and drainage ditch was removed, and extra carbon was used in water treatment. The maximum levels of toxaphene detected in the reservoir was 10 ppb.

- A landfill in Allegheny County, Pennsylvania, accepted heavy metal industrial sludges in addition to municipal wastes and up to 15,000 gallons/day of steel mill wastewaters. An estimated 50,000 gallons/day of leachate contaminated the local groundwater and surface water. This resulted in the landfill's temporary closure in 1973 after a lengthy court battle.

- Leachate contamination of a creek passing through the site of a former landfill in Chester County, Pennsylvania, was noticed in 1949 by a pharmaceutical company established on the property after the landfill closed. At that time, there were high levels of carbon oxygen demand and biological oxygen demand coupled with a low pH in the streams flowing through the property. In 1967, further testing of creek waters revealed 530 ppm methyl cyanide, 750 ppm methylene chloride, 550 ppm acetone, and 230 ppm ethanol. Some of the recent pollution is the result of spraying chemical effluent on the property, which was practiced for several years by the pharmaceutical company.

- In Columbia, Tennessee, leached phenolic material, from an old dump in which pitch from the manufacture of carbon electrodes had been discarded 30 previously, apparently migrated through the subsurface and emerged in Duck River in 1971. Phenolic material appeared in the Duck River as a groundwater inflow. Borings were used to learn the extent of the plume and pinpoint the source.

- One morning in July of 1972, a health officer in Westchester County, New York, received a phone call from a police sergeant reporting that one of his patrolmen had observed an employee of a local company emptying a truck tank into a catch basin near Mamoroneck Village. The employee informed the policeman that he was emptying a tank of pesticide called Aldrite because his truck tank had clogged. Approximately 50 gallons of this material was dumped into the catch basin, which is a street sewer built into a curb. This catch basin sewer empties into the Guion Creek, flows into Mamoroneck Harbor, and finally flows into Long Island Sound. The pesticide, most of which remained on the bottom of the catch basin, was pumped out and removed from the area.

- In 1967 in Hardeman County, Tennessee, highly toxic liquid and solid wastes from the manufacture of pesticides were placed in used steel drums and buried in shallow unlined trenches. Ruptures in the containers and lack of lids has permitted the wastes to escape to the subsurface environment.

Highly toxic chlorinated hydrocarbon compounds were detected in core samples from beneath the trench. Contaminants threaten the local groundwater beneath approximately 300 acres.

- An underground water supply in Ocean County, New Jersey, was seriously polluted in 1974 when several barrels containing potent chemicals leaked their contents into the ground at a landfill.

- In March 1971, leaky fittings or casings on an injection well used by an oil company for the disposal of processing wastes allowed phenolic compounds to enter Fox Creek, which served as the water supply for a nearby town. Surface soil in an adjacent basin being prepared for a new reservoir was also contaminated. Though the levels of phenol were within acceptable limits, the water was unpalatable for a period of time.

- A landfill accepting miscellaneous wastes in Gloucester County, New Jersey, is suspected as the source of chemical leachate responsible for a fish kill in a nearby lake. The leachate, which still bleeds into streams in the area, is further contaminated by chemical wastes from a manufacturing plant. Abatement of the resulting groundwater pollution is estimated to cost two to three million dollars.

- In 1971, a chemical company contracted with a trucker to haul approximately 6,000 drums of petrochemical wastes to a landfill. Instead, most of these wastes were transported to an abandoned chicken farm in Dover, New Jersey, where they were stockpiled and subsequently dumped. Within two years, nearly 200 private wells were condemned when petrochemical contamination of an aquifer was discovered.

- During World War II in Lansing, Michigan, picric acid was discharged into a pit at a chemical plant. The acid infiltrated through 70 feet of glacial drift before entering an aquifer. Contamination extended laterally for the length of a city block.

- Foundry wastes and wastes from a cork company are leaching heavy metals into groundwater and into the Susquehanna River in Lancaster County, Pennsylvania.

- Leachate from a landfill in Lancaster County, Pennsylvania, contaminated two private wells in 1960 and a spring-fed run in 1971. The landfill received 55-gallon drums containing beryllium and nickel compounds over a period of several years. The state requested that the landfill cease to accept hazardous wastes and that it be lined.

- In the Gales Ferry areas of Connecticut in 1961, a noxious odor in water drawn from several of 15 new residential wells prompted an investigation by the State Water Resources Commission. The principle odorous contaminant was styrene, an aromatic hydrocarbon. Because of the intense heat it generates during combustion, waste styrene had been used to burn brush in clearing land for the housing development. At least two leftover drums partially filled with styrene had reportedly been buried beneath 1-4 feet of fill at two separate places at Gales Ferry. In 1961 and 1962, all known contaminated material was removed from the ground, and filters of activated charcoal were placed in the new wells. By the end of 1964, no styrene was detected in any of the wells previously affected.

- Fifty-five-gallon drums of chromic acid from plating operations were dumped into a landfill in Windsor, Connecticut. Stream pollution occurred via a pipe under the landfill. The Connecticut Water Compliance Board ordered an immediate halt to the dumping in 1965 when it became aware of the disposal practices.

- Groundwater contamination in the Meridan, Connecticut, area has been documented since 1974, when a resident complained of his well water containing hydrocarbons. The contamination was traced to dumping and spillage of gasoline into floor drains connected to dry wells at a nearby gasoline station.

- From the mid-1950's until 1966, spent industrial solvents and acids were disposed in an on-land disposal pit at a site in Woodbury Township. In May of 1966, a private well near the disposal site was found to be contaminated with one of the industrial solvents being discharged into the disposal pit. It had taken 10 years for the pollution of the groundwater system to be discovered. It was a costly and difficult matter to pump out the aquifer and dispose of the contaminated groundwater.

- In 1966, it was reported that a domestic well in Woodbury, Minnesota, had developed a "severe" taste and odor. Extensive laboratory investigations determined that the cause of the taste and odor was due to a small concentration of isopropxl ether from an industrial disposal site. Barrier wells were constructed to limit the contamination to within a small area, keeping the residential well clean by reversing the natural groundwater gradient in the vicinity of the scrap disposal pits.

- In 1970, approximately 250 dump sites in Minnesota had water pollution problems. Many of those were contaminated groundwater either through actual disposal in the water table or from contaminants leaching from the fill into the water table. A typical operation had been excavated to a depth many feet below the water table. When the quarry operation ceased, it was decided to fill the site with solid waste. For many years, all types of refuse were deposited in the quarry.

- In 1966 in Minneapolis-St. Paul, Minnesota, an industrial solvent (isopropyl ether) disposed in pits from mid-1950's to 1966 contaminated a private well near the disposal site An aquifer in the vicinity of the pits was contaminated.

- After several residents of New Brunswick, New Jersey, complained of their water tasting like kerosene, the city tested the water and detected traces of a deteriorated asphalt compounds in it. The taste was actually caused by asphalt particles that had apparently been chemically broken down after a gasoline spill in a parking lot, and then hosed off the parking lot to drain into the water supply.

- Pesticides were disposed on the ground approximately thirty feet from a well in Polk, Arkansas in 1974. Water sampled from the well contained 0.07 ppb lindane and 5.7 ppb toxaphene. The water was allowed to run and became usable again after a month.

- In 1969, seven waste oil pits were abandoned in Whitehouse, Florida, which had been used as a disposal site for acid sludge and clay wastes from a petroleum re-refiner. During minor repair work in 1976, the levee on one of the major oil pits collapsed, sending 50,000 gallons of waste oil materials high in polychlorinated biphenyls into McGirts Creek. The spilled material was pumped from the creek and disposed at an old titanium mine pit being filled with sewage, septic, and other industrial sludges.

- Approximately 20,000 to 30,000 gallons of highly alkaline liquid were included in glass manufacturing wastes disposed of in Mercer County, Pennsylvania. The company disposed of the wastes in a three-acre swamp adjacent to McCutcheon Run. Caustic soda, soda ash, and other alkaline material were dumped there over a two year period. In May 1975, the owner of the property drained the swamp which caused a five mile fish kill in McCutcheon Run. The pH was tested at 10.6.

- At an industrial and municipal landfill in York County, Pennsylvania, leaching of chemical sludge polluted streams and groundwater in the area.

- In 1969, wells were contaminated in Bucks County, Pennsylvania, by leachate from a quarry that accepted a variety of wastes from plastics and pharmaceutical companies. Monitoring of wells in the area in 1975 revealed 0.99 ppm manganese, 84 ppm ammonia, 686 ppm chloride, and 0.1 ppm phenols in the water. The site was prohibited from receiving chemical wastes in 1971.

- Leachate from a strip mine pit in which acid-laden sludge was dumped, was to blame for the contamination of several wells and the destruction of aquatic life in a local residents' lake in Lawrence County, Pennsylvania. The sludge, composed primarily of spent pickle liquors, originated from a company in the area.

- Surface discharge of lagoonal waste from an aluminum company in Wellsville, Pennsylvania, caused pollution of Doe Run, which eventually flows into the Susquehanna River. Complaints of high aluminum concentrations began in August 1965.

- Wells and quarry water in Chester County, Pennsylvania, were contaminated by high concentrations of lithium, in some cases exceeding 15 mg/l. A pharmaceutical company that had illegally dumped lithium-containing wastes into an old abandoned quarry proved to be the source of the wastes.

- Leachate from an impoundment of spent pickle liquor in Westmoreland County, Pennsylvania, caused stream contamination. As a result of legal proceedings, the leaky lagoons no longer accept wastes, and new lined lagoons were constructed.

- Impoundment leakage and leachate from seepage beds and spraying fields of a gas supply company in Clinton County, Pennsylvania, has contaminated groundwater in the disposal area. Investigation revealed a high concentration of iron, manganese, and chlorine in the groundwater resulting from the leachate. The contamination resulted in the abandonment of company wells.

- Groundwater and a stream near a chemical company located in Lycoming County, Pennsylvania have been polluted by an overflow and leachate from the company's waste impoundments. Since the lagoon flooding in 1972, the lagoons have been lined and are used as settling basins prior to discharge to the city sewer system.

- Spring and creek waters were contaminated by impoundment leakage at a canning company in Centre County, Pennsylvania. The spray irrigation of waste caustic solution used for peeling potatoes and containing sodium hydroxide resulted in a chemical reaction of sodium with the clay minerals in the soil. This reaction decreased soil permeability, allowing a polluting runoff which has contaminated several creeks and springs.

- Seven private wells were contaminated by leakage of 55-gallon drums containing paint solvents dumped at a landfill in Kutztown, Pennsylvania.

- Groundwater contamination has resulted from the disposal of fly ash in a limestone quarry located in Franklin County, Pennsylvania. The fly ash originated from a company which collects wastes generated by a firm in Maryland. Analysis of groundwater in the vicinity of the quarry revealed high concentrations of iron, zinc and sulfates, and a low pH.

- Leachate from a landfill in Butler County, Pennsylvania, contaminated a spring about 1/4 mile away that was used as a residential water supply. Among the wastes accepted by the landfill were test paints, thinners, and solvents. Because of the contamination, court action halted hazardous waste dumping for a brief period of time.

- Groundwater flowing through an impoundment of a company in Clinton County, Pennsylvania, caused the contamination of an unnamed tributary of Bald Eagle Creek and about 20 area wells. The polluted waters contained a high carbon oxygen demand, a high biological oxygen demand, ammonia, nitrogen, and oil wastes. A 5,000-gallon glass tank has been constructed to serve as a holding reservoir to replace the waste pond.

- Seepage from a sludge pond of an oil refinery in Warren County, Pennsylvania, caused a massive fish kill in the Allegheny River in September 1972. The oil refinery began using the pond as a sludge lagoon in the 1920's. In the 1950's it changed hands, and sawdust and residential wastes were dumped there. Heavy rains in September of 1972 caused an earthen dike in the lagoon to leak, spilling wastes into the Allegheny River and killing 453,600 fish up to 60 miles downstream. PH of the discharge was 1.7; iron 507.3 ppm, sulfate 56.5 ppm, chemical oxygen demand 116,112 ppm. Lagoon samples taken in March 1974 revealed a pH of 2.7, sulfate 572 ppm, chemical oxygen demand 1530 ppm, and iron 79.6 ppm.

- In 1965, in Centre County, Pennsylvania, phenolic materials and solvents from chemical companies process wastes were released to a disposal lagoon and then sprayed on the land surface. A contaminated zone 4,000 feet long and 300 feet wide was formed within the shallow carbonate-rock aquifer. The zone of contamination included only one spring and no wells.

- In 1968 in Kalispell, Montana, plywood glue wastes were dumped into a pit dug below the water table and phenolic compounds were added to the groundwater. A medicinal taste and brown tinge was reported by several well owners. Dilution by Flathead River helped to keep the problem from being more widespread.

- In 1969 industrial waste from a Kansas City landfill leached into a fresh water aquifer and then into a stream. Organic compounds and phenolics in the leachate entered the Kansas City, Missouri, waterworks intake. Subsequent chlorination produced a highly obnoxious medicinal taste and odor.

- In 1968 in Cattanaugus County, New York, chromium leached from plating wastes that were discarded in solid form on the land surface. Chromium contamination (2.5 mg/l) was found in one industrial well 450 feet from the waste pile.

- In 1972 in Middlesex County, New Jersey, industrial wastes from a disposal lagoon have migrated downward to the water table. The well supply for a large population in Perth Amboy has been condemned due to contamination by excessive concentrations of iron, zinc and chloride.

- In 1971 in Warren County, New Jersey, ammonia and mercury-laden wastes that have been spilled or leaked from a chemical manufacturing plant have infiltrated to the water table. Three industrial supply wells with a combined production rate of 3,000 gpm are affected.

- From 1969 to 1970 in Palm Beach, Florida, acidic, high temperature industrial waste injected into the lower saline part of an aquifer moved upward into the overlying upper strata which contained brackish water (1,000 mg/l of chloride). This caused localized contamination of the artesian brackish water bearing upper Floridan aquifer. Increases in concentration of organic carbon, chemical oxygen demand, methane, carbon dioxide, and hydrogen sulfide have been observed.

- In 1961 in San Joaquin Valley, California, salt and lye solutions were discharged to the land surface by the olive-processing industry. Analyses of chloride concentration in the wastewaters from several processing plants ranged from 100 to 68,600 mg/l. Analyses indicated the chloride concentration of water from wells near the disposal areas increased about 150 mg/l over a 10 year period.

- In 1956 in Riverside County, California, chrome plating wastes were discharged on the ground and into a cesspool. Samples from four wells contained concentrations of hexavalent chromium of as much as 3 mg/l and 18 others contained trace amounts. By 1959 the content in the four wells had decreased but was still above allowable limits.

- In 1960, in Suffolk County, Long Island, New York, leachage from a sanitary landfill which received both solid and liquid wastes degraded the groundwater in the shallowest aquifer. A detailed study is being made of the type, concentration, and mobility of various chemical contaminants that are being leached from the active landfill. Thus far, the following contaminants have been detected, some in concentrations that exceed drinking water standards: arsenic, copper, lead, selenium and zinc. Other contaminants are manganese, iron and mercury.

- In the 1940's in Allegan County, Michigan, chrome-plating wastes were discharged into an infiltration pit for about three years. A glacial-drift aquifer was contaminated for at least 1,000 feet in one direction from the pit and to a depth of at least 37 feet. All private wells in the village were condemned because there was no practical way to test the water quality in each one. Water from wells supplying the village had a chromate content of 10.8 mg/l.

- In 1971, in New Castle County, New Castle, Delaware, leachate from an abandoned industrial and municipal dump containing high iron, manganese, hardness, and chemical oxygen demand has seeped into the subsurface and migrated downward to the water table. The water is unfit for drinking in two known domestic wells. The situation poses a possible threat to a five mgd public water supply.

- In 1971, in Sandoval County, New Mexico, seepage of waste disposal effluent occurred from a storage battery plant to freshwater aquifers. Unacceptable levels of arsenic (1.04 mg/l) were observed in groundwater taken from domestic wells.

- In 1971, in New Castle County, Delaware, leachate from a city landfill containing arsenic, surfactants, cyanides, high iron, lead, and manganese, has entered the shallow watertable aquifer. Contaminants have moved one-third of the distance from landfill to city well fields as shown by chemical analyses of water from observation wells.

- In May 1974, nearly 30 wells were found to be contaminated, 200 families affected and three cattle killed on a farm in Byron, Illinois. Extreme concentrations of cyanide were found in the cattle. A lung tissue sample from the large male Holstein revealed 2020 g/L of cyanide. Upon learning of the magnitude of the situation, the company that had purchased the property contracted for monitoring and detoxification of the area, which had been a dumping ground for industrial wastes such as CN, heavy metals, calcium, copper, iron, lead, maganese, nickel, silver, zinc, petroleum products, and acids and arsenic salts. Other environmental damage resulting from the unregulated disposal of these industrial wastes include wildlife kills of fish, birds, downstream aquatic communities, frogs, benthic community, domestic animals along the stream, and destruction of local vegetation. The organic wastes were sent to an incineration facility in Kansas City, Missouri, while other wastes such as phenols, organics, and the like were sent to a hazardous waste treatment facility in Gary, Indiana. The cleanup crew found evidence of containers which were deliberately hacked open for wastes to drain out, containers left in the open and dumped into intermittent stream channels tributary to the Rock River, and other cases of abuse.

- A marked deterioration in water quality occurred in the Marquette Heights, Illinois, area well field in 1968, after the wells had been pumped for only a few weeks. Increases in calcium and manganese content of the water could be attributed to intercepted outflow from the bluff area. The concentrations of sodium, chlorine, and total dissolved minerals were abnormally high for bedrock waters. An investigation revealed that the highs in these chemical constituents were caused by water softener waste discharged into a surface depression near the wells.

- In 1973, a complaint was received in Spokane County, Washington, of an ammonia odor emanating from an uncovered landfill where "blocks" of 60 percent sodium and potassium chloride material were dropped by an aluminum reprocessing plant. In 1974, two domestic water supplies nearby were contaminated with 600 to 1,000 ppm chlorides. The material was disposed thereafter at a different landfill.

- A disposal company undertook to dispose of some drums containing unidentified toxic residues. Instead of properly disposing of this material, the company dropped these drums at a dump located in Riverside County, California. Later during a heavy flood, the drums were unearthed, giving off poisonous gases and contaminating the water. Steps were taken to properly dispose of the unearthed drums.

- Rainwater and groundwater percolating through a landfill in New Castle, Delaware, have produced a putrid-smelling leachate that contaminated the New Castle water supply and domestic wells. The composition and strength of the leachate varies according to the amount of water contacting the refuse material, but it generally contains high concentrations of iron, chlorides, ammonia, phenols, some heavy metals, and dissolved organics. It will cost the taxpayers of New Castle $2.2 million to clean up the polluted water.

- Domestic refuse collected throughout Miami County, Ohio, is burned in the county's incinerator, and the unburned residual material and bottom ash is buried daily in the county landfill. Liquid industrial wastes are also accepted at the landfill. Scrubber water containing fly ash from the stack discharges into a nearby infiltration pit. These disposal practices have resulted in contamination of the aquifer with organic solvents, chlorides, and iron. In addition, the temperature of water in the major well on the site has risen 10 F. This pollution does present a threat to the water supply of several organizations and residents located within one mile of the site.

- Leachate from a Beaver County, Pennsylvania, landfill that accepted oils and sludges, heavy metals, and organic compounds destroyed life in a nearby stream, emitting a noxious odor which prevaded the area surrounding the landfill. By 1974, the company was no longer accepting waste liquids or heavy metals.

- In 1973, a spectacular fire occurred at a hazardous waste incineration facility located in Shakopee, Minnesota. The fire, of unknown origin, broke out in a diked drum storage area and consumed the contents of approximately 4,000 55-gallon drums. The drums contained combustible hazardous wastes including paint sludges, solvents, and waste oils. Fortunately, the facility had been shut down for the holidays and no employees were present.

- A fire broke out when a powdered aluminum, magnesium, and phosphorous compound was dumped at a landfill in Seattle, Washington, in 1974. The waste compound originated from cleaning debris from the site of a metal reduction plant. After unsuccessful attempts to douse the explosive fire with water, the debris was spread out and allowed to smoulder.

- A family in Warick County, Coventry, Rhode Island, was charged with illegal trucking and dumping of hazardous wastes at a pig farm, following a large fire and several explosions at the dump site. The chemicals, which were dumped in an open pit included xylene, toluene, and carbon tetrachloride and are expected to leach into the Mossup River.

- In April 1971, a pesticide formulating company in Pierce County, Washington, left approximately eleven tons of unwanted toxic chemicals at the town dump. Among these chemicals left in the open were seven tons of 4 percent toxaphene and 1.5 percent rotenone, and 1300 pounds of 70 percent calcium arsenate. Additional chemicals included pyrethrum, lethane, hydroxylated copper and DDT. The chemicals were removed from the dump before any damage to the environment occurred.

- In Louisville, Kentucky, in 1977, a wastewater treatment plant was shut down after receiving large amounts of hexachlorocyclopentadiene and octa-chlorocyclopentene. Concentrations of "hexa" reached 47,000 ppm in sewer sediments and 32 plant employees experienced watering eyes, respiratory ailments, or other ill effects due to the heavy vapors associated with the contaminants. As a result, 105 million gallons per day of raw sewage were discharged to the Ohio River for more than two months. It was estimated that the total diversion amounted to over 9 billion gallons of raw sewage while cleanup costs reached over $450,000.

- At a dump in Contra Costa County, California, a large number of drums containing solvents were deposited in a landfill. In the immediate area were leaky containers of concentrated mineral acids and several bags containing beryllium wastes in dust form. The operators failed to cover the waste at the end of the day. The acids reacted with the solvents during the night, ignited them and started a large chemical fire. There was possible dispersion of potentially hazardous beryllium dust into the environment.

- In Los Angeles County, California, a tank truck emptied several thousand gallons of cyanide waste onto refuse at a sanitary landfill. Another truck subsequently deposited several thousand gallons of acid waste at the same location. Reaction between the acid and the cyanide involved large amounts of toxic hydrogen cyanide gas. A potential disaster was averted when a local chlorine dealer was quickly called to oxidize the cyanide with chlorine solution.

- The contents of some 250 steel drums of cyanide and miscellaneous organics at a landfill in Lake City, Georgia, leaked into the air. Apparently the containers surfaced due to a chemical reaction, emitting a foul odor and white clouds that blanketed the area. The chemical containers were reburied later that day, posing no danger to the residents nearby.

- A load of empty pesticide containers was delivered to a disposal site in Fresno County, California. Unknown to the site operator, several full drums of an acetone-methanol mixture was included in the load. When the load was compacted by a bulldozer, the barreled waste ignited, engulfing the bulldozer in flames. The ensuing fire involved dispersion of pesticide wastes.

- Air samples collected in the vicinity of a landfill in Edison, New Jersey, indicated that vinyl chloride is continuously emitted from the landfill and that significant ambient concentrations are present in the surrounding areas. Vinyl chloride levels as high as 0.4 ppm were found in a residential area one mile from the landfill and 0.5 ppm at the landfill.

- Two serious fires occurred at a landfill in St. Clare County, Illinois, in 1973 and 1974. The landfill had accepted various industrial wastes, including solvents and wastes from plastics manufacture for ten years. Both fires burned for two days, involved personal danger and were difficult to extinguish. Leachate and runoff have contributed to water degradation in a nearby stream. The site no longer accepts barrels of unknown chemicals and can only dispose of non-hazardous industrial wastes.

- At a land disposal site in Southern California, a tanker was observed unloading a waste listed as "waste acid" into a subsurface, bottomless tank through an open stack above the ground. Shortly after the unloading operation commenced, yellowish-brown clouds of nitrogen dioxide began to emanate from the open stack. The reactions appeared to have subsided when the discharging of the wastes ceased. However, an hour later, more nitrogen dioxide started to spew from the stack. The emission was halted by filling the stack with soil. There were no reported injuries, but the incident created a significant air pollution problem such that complaints from nearby businesses were received and a factory was evacuated.

- Land disposal of batches of pesticide concentrates including arsenic has polluted approximately 40 percent of the land area of a company disposal site in Middleport, New York. Impoundment of surface runoff and treatment prior to discharge is now required.

- A waste-oil firm dumped large quantities of PCB contaminated soil in a pit adjacent to a tributary to the Meramec River. The contaminated area was estimated at 2,500 square feet, with soil samples containing 1.4 to 1.8 percent (14,000-18,000 ppm) PCB. Part of the cleanup operation involved diversion of the creek away from the site and the removal of about 50,000 gallons of contaminated soil.

- Hexachlorobenzene (HCB) wastes were disposed in landfill sites in southern Louisiana. Some of the waste was covered following disposal, some was not. Soil and plant samples taken near the landfill area showed a decreasing HCB content as distance from the landfill increased. The HCB levels in the plasma of landfill workers was reported to range from 2 to 345 ppb; the average level in a control was 0.5 ppb with a high of 1.8 ppb. A study of the land disposal of the hexachlorobenzene wastes indicated that uncovered wastes released 317 kilograms per hectare per year.

- Chromium-bearing plating wastes were filtered through Fuller's Earth, and then the contaminated Fuller's Earth was dumped in a pit at a company site. Hexavalent chromium leached into the groundwater and traveled at least 450 feet into a nearby domestic well. There, a marked change in the water prompted the owner to ask the state for chemical analysis. Because this was a health hazard, the company had the Fuller's Earth dug up and removed. The chromium content of the well water dropped gradually to acceptable levels.

- In 1972, approximately 2,000 pounds of packaged technical mevinphos was buried in Waterloo, Iowa, resulting in gross contamination of vegetation in the area. The area was later neutralized with alkali, and some of the material was removed.

- For 40 years a company manufactured various mercury compounds near the Hackensack Meadowlands. In 1974, after the manufacturing plant had been demolished, it was apparent that the former one acre plant property was used as a dump for mercury wastes. Soil corings down to three feet yielded an average concentration of 1.2 percent mercury in the soil. It is estimated that there is about 200,000 pounds of total mercury at the site.

- In May 1972, a private commercial well was dug for a new office of a small contractor in Perham, Minnesota. Within the same month, 5 of 13 employees became ill with gastrointestinal ailments. Six other employees also became ill within the next two months, requiring hospitalization. One employee lost the use of his legs for six months due to severe neuropathy. After several weeks it was discovered that the well was located 20 feet from a site where approximately 50 pounds of a pesticide had been buried between 1934 and 1936. The pesticide which consisted of arsenic trioxide, bran, sawdust, and molasses had been buried at a depthfeet, while the affected well was 31 feet deep. Well contained up to 21 ppm arsenic. Soil samples contained up to 12,600 ppm of arsenic in the vicinity of the burial spot. To date, the affected well has been capped and an alternate water supply obtained at a cost of about $300. Twelve nearby wells are also monitored periodically to establish the threat to the Perham municipal well field 3/4 of way.

- In 1973, dangerous concentrations of arsenic, lindane, silvex, endrin, PCB's, and dieldrin were discovered in the Potomac River as well as in the soil surrounding an Alexandria, Virginia, chemical plant. Mercury in excess of 30 ppm was also discovered. The chemicals are believed to have come from the washing of railroad cars.

- In 1973, washout from a waste lagoon at an abandoned plant in Cadosia, New York, washed an unknown amount of tarlike residue from acid manufacture into the West Branch of the Delaware River.

- A paper company in Wood County, Wisconsin, had been placing $CaCO_3$ in sludge pits as part of its processing operations. The slurry dried in these pits and was used as an agricultural soil sweetner. Leachate beneath the pits was discharged into the adjacent Wisconsin River. Monitoring wells located between the sludge pits and the river indicate: total dissolved solids 440 mg/l, iron 12 mg/l, sulfate 901 mg/l and a pH of 12.5.

APPENDIX K

UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE, IN STANDARD INDUSTRIAL CLASSIFICATIONS 20 AND 22 THROUGH 39 -- 1972

TABLE K-1
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 20 - FOOD AND KINDRED PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	102	37	44	42	27	20	3	3	-	-	278
Maine	86	41	30	44	18	24	9	3	-	-	255
Massachusetts	260	93	96	128	82	60	17	8	-	-	744
New Hampshire	45	7	14	19	4	7	2	-	-		98
Rhode Island	70	25	25	24	12	7	-	3	-		166
Vermont	28	13	16	22	7	3	-	-	-	-	89
Subtotal	591	216	225	279	150	121	31	17	-	-	1,630
Region II											
Delaware	16	11	8	15	9	12	6	2	1	-	80
New Jersey	255	111	111	169	96	80	25	12	4	1	864
New York	618	321	341	362	198	132	60	16	4	-	2,052
Subtotal	889	443	460	546	303	224	91	30	9	1	2,996
Region III											
District of Columbia	3	3	4	5	2	4	1	-	-	-	22
Maryland	106	67	57	96	50	61	19	6	2	-	464
Pennsylvania	563	213	229	349	174	150	56	19	8	1	1,762
Virginia	127	46	58	119	80	67	13	5	4	-	519
West Virginia	49	14	21	33	22	13	2	-	-	-	154
Subtotal	848	343	369	602	328	295	91	30	14	1	2,921
Region IV											
Alabama	106	66	55	69	44	49	25	3	-	-	417
Florida	229	120	114	131	87	83	26	8	3	-	801
Georgia	221	71	77	111	82	59	31	19	1	-	672
Kentucky	116	38	42	83	55	32	18	4	-	-	388
Mississippi	95	32	28	64	45	33	6	5	1	-	309
North Carolina	223	59	76	139	67	73	23	5	1	1	667
South Carolina	80	30	38	51	23	25	7	1	1	-	256
Tennessee	168	58	51	105	60	64	23	9	-	-	538
Subtotal	1,238	474	481	753	463	418	159	54	7	1	4,048
Region V											
Illinois	384	168	187	254	188	146	59	23	13	2	1,424
Indiana	174	57	73	139	80	60	18	13	1	-	615
Michigan	266	117	131	176	100	77	29	6	2	1	905
Minnesota	202	107	88	144	70	87	20	7	2	1	728
Ohio	397	157	157	214	146	130	42	11	4	1	1,259
Wisconsin	450	200	175	218	130	97	22	4	2	2	1,300
Subtotal	1,873	806	811	1,145	714	597	190	64	24	7	6,231
Region VI											
Arkansas	82	36	47	64	48	41	21	6	2	-	347
Louisiana	170	49	62	113	92	62	14	4	-	-	566
New Mexico	57	22	16	29	8	9	1	-	-		142
Oklahoma	112	32	49	69	30	32	7	1	1	-	333
Texas	476	161	187	280	175	146	55	11	2	-	1,493
Subtotal	897	300	361	555	353	290	98	22	5	-	1,881
Region VII											
Iowa	183	67	91	123	59	56	20	11	8		618
Kansas	133	61	60	62	48	36	5	6	1	-	412
Missouri	207	84	83	125	76	68	26	10	1	1	681
Nebraska	90	82	66	85	49	37	13	4	4	-	430
Subtotal	613	294	300	395	232	197	64	31	12	1	2,141
Region VIII											
Colorado	106	36	60	74	35	39	12	1	1	1	365
Montana	53	30	25	24	14	4	1	-	-		151
North Dakota	46	15	31	26	6	10	1	-			135
South Dakota	37	22	16	26	13	9	2			1	126
Utah	71	31	21	40	27	16	2	-	-	-	208
Wyoming	32	8	11	4	4	3	-				62
Subtotal	345	142	164	194	99	81	18	1	1	2	1,047
Region IX											
Arizona	68	13	27	42	22	11	5	-	-	-	188
California	680	337	195	512	279	242	101	37	9	-	2,394
Hawaii	77	26	38	30	15	18	2	4		1	209
Nevada	18	2	10	8	7	3	-				48
Subtotal	843	376	470	592	323	274	110	41	9	1	3,039
Region X											
Alaska	28	19	12	25	23	4	-	-			111
Idaho	56	18	27	36	25	19	10	2	-	1	192
Oregon	123	54	47	68	52	48	11	6	-	-	409
Washington	150	58	98	104	63	43	18	3	-	-	539
Subtotal	355	149	184	233	163	114	39	11	-	1	1,251
Total	8,492	3,343	3,825	5,294	3,128	2,611	891	[illegible]	81	17	28,185

*U.S. Department of Commerce, 1976.

TABLE K-2
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 22 - TEXTILE MILL PRODUCTS

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	12	13	16	24	20	17	14	2	1	-	119
Maine	8	1	3	3	7	14	10	2	1	-	49
Massachusetts	58	32	40	81	41	40	27	7	1	-	327
New Hampshire	8	3	12	12	9	11	6	4	-		65
Rhode Island	47	23	35	46	48	43	10	2	-		254
Vermont	3	1	1	4	4	1	-	-	-	-	14
Subtotal	136	73	107	170	129	126	67	17	3	-	828
Region II											
Delaware	1	-	1	1	3	1	2	-	-	-	9
New Jersey	97	84	103	133	84	61	16	3	-	-	581
New York	231	192	276	356	171	98	24	8	-	-	1,356
Subtotal	329	276	380	490	258	160	42	11	-	-	1,946
Region III											
District of Columbia	-	-	-	-	-	-	-	-	-	-	-
Maryland	3	5	1	11	6	2	2	-	-	-	30
Pennsylvania	81	72	68	135	126	103	48	10	5	-	644
Virginia	10	3	4	12	11	26	18	17	8	1	110
West Virginia	0	0	2	1	3	-	-	1	-	-	7
Subtotal	94	80	75	159	146	129	68	28	13	1	791
Region IV											
Alabama	15	3	8	13	15	43	33	17	9	1	152
Florida	23	13	18	17	10	1	2	2	-		83
Georgia	83	42	62	87	57	113	69	48	21	-	550
Kentucky	3	2	3	5	1	3	4	1	-	1	23
Mississippi	1	4	7	4	6	5	5	3	2	-	38
North Carolina	164	87	106	244	178	296	193	94	35	4	1,399
South Carolina	36	16	20	34	43	92	98	77	18	3	437
Tennessee	25	13	9	29	19	36	22	15	4	-	172
Subtotal	352	180	214	490	350	591	477	250	89	9	2,850
Region V											
Illinois	22	11	13	16	11	7	1	2	-	-	83
Indiana	3	2	3	4	1	2	1	-	-	-	16
Michigan	13	9	6	7	1	3	1	1	-	-	41
Minnesota	3	-	5	4	7	4	1	1	-	-	19
Ohio	15	6	11	8	9	9	7	3	1	-	77
Wisconsin	15	7	3	10	4	11	8	1	-	-	59
Subtotal	69	37	48	50	29	36	17	11	1	-	290
Region VI											
Arkansas	2	2	1	7	-	1	3	1	-	-	18
Louisiana	1	3	2	1	1	2	1	1	-	-	12
New Mexico	-	1	1	-	-	-	-	1	-	-	3
Oklahoma	2	1	3	1	3	5	1	-	-	-	15
Texas	18	9	16	9	10	9	4	1	-	-	75
Subtotal	23	15	23	13	12	19	15	5	-	-	123
Region VII											
Iowa	2	-	1	4		1		-	-	-	10
Kansas	-	1	-	1	-	-	-	-	-	-	2
Missouri	8	3	3	3	3	2	1	1	-	-	27
Nebraska	2	-	-	1	2	1	-	-	-	-	5
Subtotal	12	4	8	11	4	5	1	1	-	-	39
Region VIII											
Colorado	2	1	1	-	-	-	-	-	-	-	4
Montana	-	-	-	-	1	-	-	-			1
North Dakota	-				-		-	-			-
South Dakota	-				-		-			-	-
Utah	1	1	1	1	-		1			-	5
Wyoming	-	-	-	-	-		-				-
Subtotal	3	2	2	4	1	-	1	-	-	-	10
Region IX											
Arizona	1	1	2							-	4
California	31	41	44	69	55	16	8	1	-	-	265
Hawaii	-	-	-	-	1	-	-	-	-	-	1
Nevada	-	-	-	-	-	-	-	-	-	-	-
Subtotal	32	42	46	69	56	16	8	1	-	-	271
Region X											
Alaska	-	-	-	-	-	-	-	-	-	-	-
Idaho	1	-	-	-	-	-	1	-	-	-	2
Oregon	6	1	1	4	3	1	1	3	-	-	21
Washington	7	5	1	1	3	1	1	-	-	-	17
Subtotal	14	6	2	5	6	2	3	3	-	-	40
Total	1,085	726	899	1,303	951	1,081	642	315	106	10	7,201

* U.S. Department of Commerce, 1976.

TABLE K-3
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 23 - APPAREL AND OTHER TEXTILE PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500+over)	Total
Region I											
Connecticut	45	18	35	72	59	28	7	-	-	-	264
Maine	10	3	2	11	2	7	4	1	-	-	40
Massachusetts	144	113	121	194	148	97	23	7	-	-	847
New Hampshire	7	3	3	10	10	7	-	-	-		40
Rhode Island	11	17	11	12	9	5	2	1	-		68
Vermont	4	1	5	5	4	5	-	-	-	-	24
Subtotal	221	155	177	304	232	149	36	9	-	-	1,283
Region II											
Delaware	5	3	2	6	6	6	1	-	-	-	29
New Jersey	479	270	282	484	290	115	23	3	1	-	1,947
New York	1,921	1,262	1,723	2,342	923	328	46	11	4	-	8,560
Subtotal	2,405	1,535	2,007	2,832	1,219	449	70	14	5	-	10,536
Region III											
District of Columbia	7	4	2	2	-	1	-	-	-	-	16
Maryland	56	30	29	48	55	31	20	4	-	-	273
Pennsylvania	241	154	196	585	526	290	101	14	5	-	2,112
Virginia	25	12	10	23	47	75	33	12	1	-	238
West Virginia	9	3	3	9	10	16	4	1	-	-	55
Subtotal	338	203	240	667	638	413	158	31	6	-	2,694
Region IV											
Alabama	39	16	12	14	37	77	49	14	3	-	261
Florida	234	128	146	209	88	55	11	2	-	-	873
Georgia	68	26	35	78	94	143	64	21	3	-	532
Kentucky	26	8	8	11	14	44	26	9	1	-	147
Mississippi	17	2	4	10	23	80	39	14	-	-	189
North Carolina	76	35	32	59	113	134	80	29	1	-	559
South Carolina	38	9	20	37	26	82	41	14	1	1	269
Tennessee	50	25	13	34	37	99	73	22	5	-	358
Subtotal	548	249	270	452	432	714	383	125	14	1	3,188
Region V											
Illinois	194	89	106	100	76	58	14	3	1	1	642
Indiana	50	12	21	25	22	27	18	-	-	-	175
Michigan	83	38	45	33	16	16	3	3	2	2	241
Minnesota	50	16	27	24	26	18	3	-	-	-	164
Ohio	118	48	47	55	29	33	17	2	3	-	352
Wisconsin	36	18	22	24	13	15	7	1	-	-	136
Subtotal	531	221	268	261	182	167	62	9	6	3	1,710
Region VI											
Arkansas	17	5	2	4	14	23	20	2	1	-	88
Louisiana	25	6	3	18	12	16	8	3	-	-	91
New Mexico	15	1	2	2	2	2	1	2	-		27
Oklahoma	35	7	7	8	15	23	14	-	-	-	109
Texas	200	59	64	102	112	101	43	18	6	1	706
Subtotal	292	78	78	134	155	165	86	25	7	1	1,021
Region VII											
Iowa	18	9	8	7	7	14	2	-	-	-	65
Kansas	22	6	4	13	10	12	4	-	-	-	71
Missouri	54	30	43	62	67	78	29	2	-	-	365
Nebraska	13	8	4	9	1	6	1	-	-	-	42
Subtotal	107	53	59	91	85	110	36	2	-	-	543
Region VIII											
Colorado	34	12	8	16	9	3	2	-	-	-	84
Montana	3	1	3	1	-	-	-	-	-		8
North Dakota	4	-	1	-	1	-	-	-			6
South Dakota	9	1	1	1	-	1	2			-	15
Utah	25	4	5	17	9	13	5	-	-	-	78
Wyoming	3	1	-	-	1	-	-				5
Subtotal	78	19	18	35	20	17	9	-	-	-	196
Region IX											
Arizona	24	16	14	12	6	10	5	-	1	-	88
California	769	455	530	588	274	126	25	4	3	-	2,774
Hawaii	31	17	17	33	18	3	1	-		-	120
Nevada	10	4	2	-	1	-	-				17
Subtotal	834	492	563	633	299	139	31	4	4	-	2,999
Region X											
Alaska	2	-	1	-	-	-	-	-			3
Idaho	8	4	-	1	-	1	-	-	-	-	14
Oregon	38	16	14	13	6	5	2	1	-	-	95
Washington	60	15	18	26	11	11	6	1	-	-	148
Subtotal	108	35	33	40	17	17	8	2	-	-	260
Total	5,462	3,040	3,713	5,449	3,279	2,140	879	221	42	5	26,430

* U.S. Department of Commerce, 1976.

TABLE K-4
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 24 - LUMBER AND WOOD PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	64	39	19	19	9	-	-	-	-	-	150
Maine	578	130	93	59	27	19	7	-	-	-	913
Massachusetts	178	75	67	47	26	5	1	-	-	-	399
New Hampshire	121	46	36	33	16	5	2	-	-		259
Rhode Island	22	10	6	4	-	1	-	-	-		43
Vermont	125	28	28	24	6	4	-	-	-	-	215
Subtotal	1,088	328	249	186	84	34	10	-	-	-	1,979
Region II											
Delaware	17	7	4	2	-	1	-	-	-	-	36
New Jersey	143	69	63	57	16	6	2	-	-	-	356
New York	444	221	182	139	63	23	2	1	-	-	1,075
Subtotal	604	297	249	203	79	30	4	1	-	-	1,467
Region III											
District of Columbia	1	1	2	3	-	-	-	-	-	-	7
Maryland	136	49	47	46	10	8	2	-	-	-	298
Pennsylvania	661	220	158	135	60	42	8	1	-	-	1,285
Virginia	875	208	127	103	48	41	8	3	-	-	1,413
West Virginia	329	62	35	46	19	4	2	-	1	-	498
Subtotal	2,002	540	369	333	137	95	20	4	1	-	3,501
Region IV											
Alabama	1,177	223	120	122	68	44	9	4	1	-	1,768
Florida	649	242	141	127	62	43	2	-	-	-	1,266
Georgia	1,401	322	145	122	74	54	13	-	1	-	2,132
Kentucky	300	81	62	49	39	12	3	1	-	-	547
Mississippi	531	145	70	73	56	40	17	1	1	-	934
North Carolina	1,140	268	167	191	101	57	8	2	-	-	1,954
South Carolina	853	143	84	83	39	28	3	-	-	-	1,233
Tennessee	547	108	82	90	49	40	2	1	-	-	919
Subtotal	6,598	1,552	871	857	488	318	57	9	3	-	10,753
Region V											
Illinois	242	103	95	74	36	21	2	1	1	-	575
Indiana	244	91	65	96	51	53	10	1	1	-	612
Michigan	585	191	131	102	41	31	3	1	-	-	1,085
Minnesota	319	96	53	50	26	12	1	1	1	-	557
Ohio	423	120	95	109	39	25	2	1	-	-	814
Wisconsin	399	123	100	74	43	33	11	4	-	-	787
Subtotal	2,212	722	539	505	236	175	29	9	3	-	4,430
Region VI											
Arkansas	519	111	73	94	61	46	11	2	-	-	917
Louisiana	594	129	65	66	42	26	7	1	-	-	930
New Mexico	50	19	10	18	13	4	1	-	-		115
Oklahoma	65	24	21	24	7	11	2	-	-		154
Texas	626	168	131	117	82	68	12	2	2	-	1,208
Subtotal	1,854	451	300	319	205	155	33	5	2	-	3,324
Region VII											
Iowa	87	35	22	15	7	7	1	1	1	-	176
Kansas	52	22	14	17	7	15	2	-	-	-	129
Missouri	324	107	64	74	28	14	2	1	-	-	614
Nebraska	25	16	5	11	4	7	2	-	-	-	70
Subtotal	488	180	106	117	45	43	7	2	1	-	989
Region VIII											
Colorado	98	31	26	23	14	13	-	-	-	-	205
Montana	211	56	41	38	23	14	2	2	-		387
North Dakota	8	2	2	1	4	-	-	-			17
South Dakota	21	5	7	10	4	5	-			-	52
Utah	48	22	15	11	2	8	-	-	-	-	106
Wyoming	48	7	13	7	5	1	-				81
Subtotal	434	123	104	90	52	41	2	2	-	-	848
Region IX											
Arizona	73	33	19	27	17	10	3	-	-	-	182
California	892	400	332	286	158	135	27	4	2	-	2,236
Hawaii	12	5	9	7	4	1	-	-		-	38
Nevada	9	6	4	1	1	1	-				22
Subtotal	986	444	364	321	180	147	30	4	2	-	2,478
Region X											
Alaska	41	6	10	11	8	3	1	-			80
Idaho	195	88	61	66	33	37	4	2	-	-	486
Oregon	687	312	298	254	146	141	42	11	3	-	1,894
Washington	724	319	277	195	82	75	20	6	4	-	1,702
Subtotal	1,647	725	646	526	269	256	67	19	7	-	4,162
Total	17,913	5,362	3,797	3,457	1,775	1,294	259	55	19	-	33,931

* U.S. Department of Commerce, 1976.

TABLE K-5
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 25 - FURNITURE AND FIXTURES *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	26	14	15	21	9	11	3	1	-	-	100
Maine	7	5	2	3	4	3	-	-	-	-	24
Massachusetts	93	43	44	64	25	17	3	1	-	-	290
New Hampshire	10	6	4	11	4	6	1	-	-		42
Rhode Island	9	8	4	5	2	2	-	-	-		30
Vermont	8	2	4	2	1	5	-	2	-	-	24
Subtotal	153	78	73	106	45	44	7	4	-	-	510
Region II											
Delaware	6	1	-	1	-	1	-	-	-	-	9
New Jersey	81	54	66	61	28	11	3	2	1	-	307
New York	363	235	230	182	76	54	7	3	-	-	1,150
Subtotal	450	290	296	244	104	66	10	5	1	-	1,466
Region III											
District of Columbia	4	8	1	-	1	-	-	-	-	-	14
Maryland	24	15	14	21	8	5	1	-	1	-	89
Pennsylvania	128	65	61	108	39	47	12	4	1	-	465
Virginia	31	13	12	21	19	15	15	16	3	1	146
West Virginia	5	5	6	11	5	1	-	-	-	-	33
Subtotal	192	106	94	161	72	68	28	20	5	1	747
Region IV											
Alabama	57	24	15	26	13	13	6	1	-	-	155
Florida	167	85	65	77	35	21	3	-	-	-	453
Georgia	76	37	36	41	21	15	5	4	-	-	235
Kentucky	20	11	12	19	10	9	5	-	-	-	86
Mississippi	28	9	11	14	9	22	7	6	2	-	108
North Carolina	102	47	56	100	73	86	61	22	5	1	553
South Carolina	18	5	14	8	7	7	3	1	1	-	64
Tennessee	82	40	28	43	38	31	16	6	3	1	238
Subtotal	550	258	237	328	206	204	106	40	11	2	1,942
Region V											
Illinois	138	66	62	91	51	38	14	6	1	-	467
Indiana	52	24	29	41	38	38	13	5	3	-	243
Michigan	78	44	35	58	34	28	5	4	2	1	289
Minnesota	32	15	21	17	11	10	1	1	-	-	108
Ohio	92	45	49	61	26	23	9	5	1	-	311
Wisconsin	45	22	18	26	18	15	5	2	1	-	152
Subtotal	437	216	215	294	178	152	47	23	8	1	1,570
Region VI											
Arkansas	31	15	12	18	8	18	8	2	2	-	114
Louisiana	28	10	12	6	7	1	1	-	-	-	65
New Mexico	19	3	7	3	3	-	-	-	-		35
Oklahoma	40	19	14	8	4	3	1	-	-	-	89
Texas	141	66	56	87	39	31	9	2	-	-	431
Subtotal	259	113	101	122	61	53	19	4	2	-	734
Region VII											
Iowa	23	6	5	12	8	4	1	2	-	-	61
Kansas	27	11	10	11	7	4	1	-	-	-	71
Missouri	44	28	32	30	23	13	6	-	-	-	176
Nebraska	7	9	6	5	6	1	1	1	-	-	36
Subtotal	101	54	53	58	44	22	9	3	-	-	[illegible]
Region VIII											
Colorado	27	15	9	15	12	2	-	-	-	-	80
Montana	2	1	2	2	-	-	-	-	-		7
North Dakota	3	1	1	-	-	-	-	-			5
South Dakota	4	1	1	1	-	-	-			-	7
Utah	14	11	5	6	7	2	-		-	-	45
Wyoming	1	1	-	-	-	-	-				2
Subtotal	51	30	18	24	19	4	-	-	-	-	146
Region IX											
Arizona	36	18	8	16	1	4	-	-	-	-	83
California	455	233	221	274	140	82	18	2	-	-	1,425
Hawaii	4	6	5	8	2	-	1	-		-	26
Nevada	7	4	4	2	1	-	-				18
Subtotal	502	261	238	300	144	86	19	2	-	-	1,552
Region X											
Alaska	-	-	3	-	-	-	-	-			3
Idaho	6	6	1	2	-	-	-	-	-	-	15
Oregon	37	16	15	15	7	3	1	1	-	-	95
Washington	48	16	20	23	5	6	-	-	-	-	118
Subtotal	91	38	39	40	12	9	1	1	-	-	231
Total	2,786	1,444	1,363	1,677	835	708	246	102	33	4	9,262

* U.S. Department of Commerce, 1976.

TABLE K-6
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 26 - PAPER AND ALLIED PRODUCTS*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	8	11	17	22	21	17	4	2	–	–	102
Maine	7	4	3	5	5	6	5	10	3	–	48
Massachusetts	52	33	43	60	57	75	18	6	–	–	344
New Hampshire	2	3	1	15	8	7	–	1	2		39
Rhode Island	7	4	8	17	6	4	3	–	–		49
Vermont	3	1	1	6	4	4	3	–	–	–	22
Subtotal	79	56	73	125	101	113	33	19	5	–	604
Region II											
Delaware	–	–	–	5	5	3	1	–	–	–	14
New Jersey	43	49	56	79	64	84	17	4	2	–	398
New York	161	97	128	194	113	105	31	8	2	–	839
Subtotal	204	146	184	278	182	192	49	12	4	–	1,251
Region III											
District of Columbia	1	1	–	2	–	–	1	–	–	–	5
Maryland	10	10	8	20	9	19	2	1	2	–	81
Pennsylvania	67	36	44	104	60	81	22	11	4	–	429
Virginia	6	10	14	11	14	24	7	2	3	–	91
West Virginia	4	1	1	3	6	7	1	–	–	–	23
Subtotal	88	58	67	140	89	131	33	14	9		629
Region IV											
Alabama	6	5	5	9	7	9	10	5	4	1	61
Florida	26	11	13	25	17	24	3	8	2	–	129
Georgia	16	10	16	23	19	23	12	10	5	–	134
Kentucky	3	–	2	15	10	13	4	2	–	–	49
Mississippi	6	2	3	10	5	8	4	1	2	–	41
North Carolina	11	11	11	31	22	37	4	2	3	–	132
South Carolina	9	–	5	5	11	12	5	2	4	–	53
Tennessee	10	4	9	30	20	40	4	2	4	–	123
Subtotal	87	43	64	148	111	166	46	32	24	1	722
Region V											
Illinois	57	42	57	112	68	98	23	8	2	–	467
Indiana	17	3	16	22	35	32	10	2	–	–	137
Michigan	36	21	21	54	35	56	20	8	–	–	251
Minnesota	13	11	8	13	12	22	4	6	3	1	93
Ohio	41	35	43	83	55	82	21	5	3	–	368
Wisconsin	22	13	17	28	29	50	20	19	4	–	202
Subtotal	186	125	162	312	234	340	98	48	12	1	1,518
Region VI											
Arkansas	6	2	3	11	11	12	5	4	2	–	56
Louisiana	6	1	3	10	11	12	10	6	3	–	62
New Mexico	–	–	1	1	–	–	–	–	–		2
Oklahoma	5	3	4	7	3	5	1	–	–	–	28
Texas	27	21	18	53	23	44	6	3	2	–	197
Subtotal	44	27	29	82	48	73	22	13	7	–	345
Region VII											
Iowa	4	4	4	8	8	12	3	1	–	–	44
Kansas	6	3	4	7	7	10	3	–	–	–	40
Missouri	16	14	9	30	22	28	5	2	1	–	137
Nebraska	1	1	3	3	5	4	–	–	–	–	17
Subtotal	27	22	30	48	42	54	11	3	1	–	238
Region VIII											
Colorado	5	2	7	8	11	3	1	–	–	–	37
Montana	–	1	–	–	–	–	1	–	–		2
North Dakota	1	–	–	1	–	–	–	–			2
South Dakota	1	–	–	1	–	–	–			–	2
Utah	2	1	5	3	1	2	–	–	–	–	14
Wyoming	–	–	–	–	–	–	–				–
Subtotal	9	4	12	13	12	5	2	–	–	–	57
Region IX											
Arizona	6	2	2	3	4	–	1	–	–	–	18
California	83	50	68	108	78	91	25	3	–	–	506
Hawaii	5	–	2	2	2	–	–	–		–	11
Nevada	–	1	1	–	–	–	–				2
Subtotal	94	53	73	113	84	91	26	3	–	–	537
Region X											
Alaska	–	–	–	–	–	–	1	1			2
Idaho	–	1	–	2	1	2	–	1	–	–	7
Oregon	6	4	3	6	6	12	7	7	–	–	51
Washington	10	9	5	14	10	15	13	7	3	–	86
Subtotal	16	14	8	22	17	29	21	16	3	–	146
Total	834	548	702	1,281	920	1,194	341	160	65	2	6,04

* U.S. Department of Commerce, 1976.

TABLE K-7
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 27 - PRINTING AND PUBLISHING*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	295	116	92	97	48	26	8	4	1	–	687
Maine	82	22	21	17	4	4	1	1	–	–	152
Massachusetts	597	214	243	199	65	42	16	11	5	–	1,392
New Hampshire	81	21	23	22	11	4	4	1	–		167
Rhode Island	95	34	27	20	9	6	2	1	1		195
Vermont	58	20	8	15	8	7	1	–	–	–	117
Subtotal	1,208	427	414	370	145	89	32	18	7	–	2,710
Region II											
Delaware	26	22	12	10	–	2	–	1	–	–	73
New Jersey	778	272	214	215	89	45	21	8	2	–	1,644
New York	2,802	1,139	931	718	280	140	52	30	11	6	6,109
Subtotal	3,606	1,433	1,157	943	369	187	73	39	13	6	7,826
Region III											
District of Columbia	152	61	51	46	18	1	6	1	1	1	340
Maryland	269	98	83	79	35	32	11	1	3	–	611
Pennsylvania	951	320	253	275	118	86	32	17	3	2	2,057
Virginia	300	106	81	75	29	21	1	3	2	–	620
West Virginia	98	35	20	18	3	10	3	–	–	–	187
Subtotal	1,770	620	488	493	203	150	55	24	9	3	3,815
Region IV											
Alabama	214	69	46	34	11	14	3	1	–	–	392
Florida	897	219	158	143	45	26	6	3	4	–	1,501
Georgia	417	113	72	86	34	14	7	2	1	–	746
Kentucky	201	81	47	45	21	13	2	3	2	–	415
Mississippi	132	33	35	19	12	3	1	–	–	–	235
North Carolina	348	106	98	93	37	16	4	2	1	–	705
South Carolina	159	42	36	32	7	9	7	1	–	–	298
Tennessee	421	104	57	67	35	22	6	2	4	–	718
Subtotal	2,789	767	549	519	202	117	31	14	12	–	5,000
Region V											
Illinois	1,328	499	407	424	171	119	48	14	7	4	3,021
Indiana	445	138	124	118	40	26	13	4	3	–	911
Michigan	719	277	215	146	68	47	10	4	2	1	1,489
Minnesota	449	137	121	108	47	20	8	3	1	1	895
Ohio	908	288	232	254	130	69	15	12	8	1	1,917
Wisconsin	478	157	129	110	46	31	13	5	–	1	970
Subtotal	4,327	1,496	1,228	1,160	502	312	107	42	21	8	9,203
Region VI											
Arkansas	135	46	33	35	11	6	3	–	1	–	272
Louisiana	275	66	56	42	16	8	2	1	1	–	467
New Mexico	83	24	13	18	6	1	1	–	–		146
Oklahoma	307	77	66	43	16	11	1	1	1	–	523
Texas	1,218	296	229	212	81	43	16	7	4	–	2,106
Subtotal	2,020	509	389	350	128	69	23	9	7	–	3,504
Region VII											
Iowa	391	95	94	76	26	12	3	–	1	–	700
Kansas	304	66	54	65	21	15	6	4	–	–	535
Missouri	573	212	129	136	48	32	14	2	2	1	1,149
Nebraska	198	53	41	38	18	3	3	1	–	–	355
Subtotal	1,466	426	318	315	113	62	26	7	3	1	2,739
Region VIII											
Colorado	284	69	59	49	11	12	8	1	1	–	494
Montana	63	18	11	13	2	4	–	–	–		111
North Dakota	72	16	6	13	4	3	–	–			116
South Dakota	102	14	15	9	6	2	–			–	168
Utah	99	32	22	17	3	6	2	1	–	–	182
Wyoming	30	11	10	10	2	1	–				64
Subtotal	650	180	123	111	28	28	10	2	1		1,135
Region IX											
Arizona	146	66	41	38	11	6	–	1	1	–	310
California	2,487	737	528	468	158	111	26	14	5	1	4,535
Hawaii	58	24	14	10	8	2	–	1		–	117
Nevada	49	12	14	9	1	3	1				89
Subtotal	2,740	839	597	525	178	122	27	16	6	1	5,051
Region X											
Alaska	25	12	5	3	2	1	–	–			48
Idaho	66	18	16	7	6	2	1	–	–		116
Oregon	208	73	55	40	19	5	2	–	1	–	403
Washington	311	92	68	47	13	15	4	2	1	–	553
Subtotal	610	195	144	97	40	25	7	2	2	–	1,120
TOTAL	21,186	6,890	5,407	4,885	1,908	1,161	391	173	83	19	42,103

* U.S. Department of Commerce, 1976.

TABLE K-8
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 28 - CHEMICALS AND ALLIED PRODUCTS [a]

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	52	24	20	28	12	7	5	2	3	1	154
Maine	11	6	3	9	3	1	–	–	–	–	33
Massachusetts	127	65	43	50	32	19	8	5	1	–	350
New Hampshire	10	5	4	1	–	3	–	–	–	–	23
Rhode Island	32	16	7	14	3	1	–	3	–		76
Vermont	10	1	3	4	1	–	–	–	–	–	19
Subtotal	242	117	80	106	51	31	13	10	4	1	655
Region II											
Delaware	10	5	3	11	2	2	1	5	–	1	40
New Jersey	243	95	146	209	100	98	42	20	13	4	970
New York	385	163	147	154	50	62	20	12	8	2	1,003
Subtotal	638	263	296	374	152	162	63	37	21	7	2,013
Region III											
District of Columbia	4	1	–	–	1	–	1	–	–	–	7
Maryland	46	18	29	28	28	15	6	5	2	–	177
Pennsylvania	206	80	87	122	55	43	24	13	6	1	637
Virginia	38	20	26	24	8	6	5	3	6	5	141
West Virginia	15	8	7	8	8	5	6	5	5	2	69
Subtotal	309	127	149	182	100	69	42	26	19	8	1,031
Region IV											
Alabama	35	24	22	28	12	12	4	2	2	–	141
Florida	163	61	59	61	24	12	15	1	1	1	398
Georgia	78	40	55	67	31	21	5	4	1	–	302
Kentucky	35	10	14	26	10	13	8	6	1	–	123
Mississippi	26	13	13	11	9	4	3	2	1	–	82
North Carolina	58	31	36	52	30	12	8	4	2	4	237
South Carolina	30	20	13	17	11	9	4	5	6	2	117
Tennessee	58	31	28	28	22	23	8	7	5	6	216
Subtotal	483	230	240	290	149	106	55	29	21	13	1,616
Region V											
Illinois	256	120	99	158	88	72	26	11	5	1	836
Indiana	78	24	38	32	19	12	8	7	1	2	221
Michigan	135	49	57	52	43	23	14	4	5	2	384
Minnesota	71	28	30	27	11	4	4	1	1	–	177
Ohio	200	93	110	125	75	52	29	10	7	–	701
Wisconsin	82	40	35	42	11	11	3	1	2	–	227
Subtotal	822	354	369	436	247	174	84	34	21	5	2,546
Region VI											
Arkansas	31	11	9	6	5	5	1	1	1	–	70
Louisiana	59	26	29	24	18	30	13	9	4	–	212
New Mexico	7	6	2	2	4	–	1	–	–		22
Oklahoma	58	14	11	6	6	3	–	–	–	–	98
Texas	257	101	95	127	60	50	21	20	8	1	740
Subtotal	412	158	146	165	93	88	36	30	13	1	1,142
Region VII											
Iowa	42	12	18	15	11	6	7	–	–	–	111
Kansas	30	12	12	21	11	11	4	2	–	–	103
Missouri	116	58	52	63	37	24	12	7	3	–	372
Nebraska	12	7	8	7	6	4	2	–	–	–	46
Subtotal	200	89	90	106	65	45	25	9	3	–	632
Region VIII											
Colorado	34	15	14	15	7	2	1	–	–	–	88
Montana	10	2	1	5	–	1	–	–	–		19
North Dakota	4	–	–	–	–	1	–	–			5
South Dakota	8	3	1	–	–	–	–			–	12
Utah	13	10	6	7	5	2	1	–	–	–	44
Wyoming	3	1	1	1	1	–	–				7
Subtotal	72	31	23	28	13	6	2	–	–	–	175
Region IX											
Arizona	25	11	9	7	3	2	2	–	–	–	59
California	440	193	188	248	111	68	22	6	2	–	1,278
Hawaii	13	1	2	4	–	1	–	–		–	21
Nevada	4	4	2	3	3	2	–				18
Subtotal	482	209	201	262	117	73	24	6	2	–	1,376
Region X											
Alaska	3	–	–	1	1	–	–	–			5
Idaho	10	3	1	1	1	–	1	2	1	–	20
Oregon	29	13	16	25	5	4	–	–	–	–	92
Washington	47	18	21	23	12	3	1	1	1	–	127
Subtotal	89	34	38	50	19	7	2	3	2	–	244
Total	3,749	1,612	1,632	1,999	1,006	761	346	184	106	35	11,430

[a] U.S. Department of Commerce, 1976.

TABLE K-9
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 29 - PETROLEUM AND COAL PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	13	5	3	1	1	2	–	–	–	–	25
Maine	1	2	–	2	1	1	–	–	–	–	7
Massachusetts	18	24	11	4	2	4	1	–	–	–	64
New Hampshire	1	–	2	2	–	–	–	–	–		5
Rhode Island	1	3	–	–	2	–	–	–	–		6
Vermont	–	–	–	–	–	–	–	–	–	–	–
Subtotal	34	34	16	9	6	7	1	–	–	–	107
Region II											
Delaware	4	–	1	–	–	2	–	1	–	–	8
New Jersey	14	18	16	17	10	6	3	1	2	–	87
New York	57	53	21	19	3	4	–	1	–	–	158
Subtotal	75	71	38	36	13	12	3	3	2	–	253
Region III											
District of Columbia	2	–	–	–	–	–	–	–	–	–	2
Maryland	7	9	5	6	6	1	1	–	–	–	35
Pennsylvania	37	44	27	17	14	9	4	2	2	1	157
Virginia	12	7	1	–	–	1	–	–	–	–	21
West Virginia	8	7	1	4	2	3	–	–	–	–	23
Subtotal	66	67	34	27	22	14	5	2	2	1	238
Region IV											
Alabama	8	11	3	5	3	3	–	–	–	–	33
Florida	16	11	9	12	2	1	–	–	–	–	51
Georgia	14	11	6	5	6	4	–	–	–	–	46
Kentucky	10	9	4	1	1	1	–	1	–	–	27
Mississippi	3	3	3	6	1	2	–	1	–	–	19
North Carolina	8	4	6	1	1	–	–	–	–	–	20
South Carolina	1	1	3	–	–	1	–	–	–	–	6
Tennessee	14	6	11	5	1	2	–	–	–	–	39
Subtotal	74	58	45	35	15	14	–	2	–	–	243
Region V											
Illinois	22	13	14	18	6	11	5	6	1	–	96
Indiana	12	8	7	12	3	5	1	–	1	1	50
Michigan	17	16	12	16	4	1	3	–	–	–	69
Minnesota	6	7	8	4	2	2	2	–	–	–	31
Ohio	57	41	24	26	12	5	1	4	–	–	170
Wisconsin	14	6	6	6	–	1	–	–	–	–	33
Subtotal	128	91	71	82	27	25	12	10	2	1	449
Region VI											
Arkansas	8	11	3	5	3	3	–	–	–	–	33
Louisiana	9	7	9	13	3	7	5	3	1	1	58
New Mexico	3	1	1	–	3	–	–	–	–		8
Oklahoma	8	9	6	4	2	10	3	1	1	–	42
Texas	45	15	16	22	12	19	12	6	6	2	155
Subtotal	73	43	35	44	23	39	20	10	8	3	296
Region VII											
Iowa	6	1	3	5	1	–	–	–	–	–	16
Kansas	3	3	2	7	–	6	4	1	–	–	26
Missouri	8	10	8	10	2	3	–	1	–	–	42
Nebraska	2	1	–	2	2	–	–	–	–	–	7
Subtotal	19	15	13	24	5	9	4	2	–	–	91
Region VIII											
Colorado	6	–	5	1	2	4	–	–	–	–	18
Montana	2	–	1	2	1	2	1	–	–		9
North Dakota	1	–	–	2	–	1	–	–			4
South Dakota	1	–	2	–	–	–	–				3
Utah	3	3	1	2	2	3	–	–	–	–	14
Wyoming	5	–	3	–	1	4	2				15
Subtotal	18	3	12	7	6	14	3	–	–	–	63
Region IX											
Arizona	8	11	3	5	3	3	–	–	–	–	33
California	81	32	12	30	16	13	3	7	3	–	217
Hawaii	1	–	–	1	2	1	–	–		–	5
Nevada	2	–	–	–	–	–	–				2
Subtotal	92	43	15	36	21	17	3	7	3	–	257
Region X											
Alaska	8	11	3	5	3	3	–	–	–	–	33
Idaho	–	1	1	–	–	–	–	–	–	–	2
Oregon	2	3	4	5	3	1	–	–	–	–	18
Washington	8	2	6	6	3	–	5	–	–	–	30
Subtotal	18	17	14	16	9	4	5	–	–	–	83
Total	581	442	313	316	147	155	56	36	17	5	2,080

* U.S. Department of Commerce, 1976.

TABLE K-10
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 30 - RUBBER AND PLASTICS PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	54	30	27	38	24	22	2	4	1	1	203
Maine	11	3	3	4	1	2	3	3	-	-	30
Massachusetts	100	52	70	102	71	47	12	5	5	-	464
New Hampshire	15	1	5	7	4	11	3	2	1		51
Rhode Island	22	16	13	18	8	8	3	2	-		90
Vermont	4	2	2	3	1	2	2	1	-	-	17
Subtotal	206	106	120	172	109	92	25	17	7	1	855
Region II											
Delaware	6	1	4	8	1	7	2	-	2	-	31
New Jersey	136	92	91	140	102	71	15	8	1	-	656
New York	257	127	127	181	93	69	15	5	2	-	876
Subtotal	399	220	222	329	196	147	32	13	5	-	1,563
Region III											
District of Columbia	3	-	-	-	-	-	-	-	-	-	3
Maryland	12	12	16	15	8	10	5	1	2	-	81
Pennsylvania	100	75	69	83	59	44	18	8	5	1	462
Virginia	17	11	5	10	9	8	9	2	4	-	75
West Virginia	8	1	4	5	2	5	1	-	-	-	26
Subtotal	140	99	94	113	78	67	33	11	11	1	647
Region IV											
Alabama	21	8	9	11	6	5	3	3	2	1	69
Florida	123	56	44	62	24	7	4	-	1	-	321
Georgia	40	23	15	28	24	18	2	2	2	-	154
Kentucky	19	3	10	5	6	10	3	1	1	-	58
Mississippi	8	2	6	13	5	7	2	3	1	-	47
North Carolina	29	22	23	22	25	22	8	2	3	-	156
South Carolina	16	8	10	9	5	12	3	1	1	-	65
Tennessee	31	16	16	22	15	20	9	5	1	1	136
Subtotal	287	138	133	172	110	101	34	17	12	2	1,006
Region V											
Illinois	153	91	88	152	81	76	16	4	4	-	665
Indiana	56	29	38	47	41	36	20	8	4	-	279
Michigan	115	88	70	117	52	40	16	3	1	1	483
Minnesota	52	27	35	42	23	13	6	-	-	-	198
Ohio	189	81	89	141	112	98	30	16	12	4	772
Wisconsin	49	18	30	46	30	23	5	1	-	1	203
Subtotal	614	314	350	545	339	286	93	32	21	6	2,600
Region VI											
Arkansas	12	7	5	8	6	6	8	1	1	-	54
Louisiana	19	6	4	2	4	2	-	-	-	-	37
New Mexico	5	4	6	1	2	-	-	-	-		18
Oklahoma	33	10	8	7	4	9	1	1	2	-	75
Texas	129	60	49	67	39	26	6	1	2	-	379
Subtotal	198	87	72	85	55	43	15	3	5	-	563
Region VII											
Iowa	12	9	6	14	15	4	2	1	1	1	67
Kansas	31	6	13	17	8	5	1	1	-	1	83
Missouri	44	25	24	41	29	16	3	-	1	-	183
Nebraska	7	2	2	10	2	6	1	-	1	-	31
Subtotal	94	42	45	82	54	31	7	2	3	2	364
Region VIII											
Colorado	27	13	13	10	3	3	1	1	-	1	72
Montana	4	-	-	-	-	-	-	-	-		4
North Dakota	2	1	1	-	-	-	-	-			6
South Dakota	5	3	1	1	1	1	-			-	12
Utah	11	12	4	7	2	2	-	-	-	-	38
Wyoming	-	1	-	1	1	-	-			-	1
Subtotal	49	32	19	19	7	6	1	1		1	135
Region IX											
Arizona	24	5	6	10	6	5	-	-	-	-	56
California	421	195	176	233	119	93	20	6	5	-	1,268
Hawaii	4	1	1	5	-	-	-	-		-	11
Nevada	5	1	2	-	-	-	-				8
Subtotal	454	202	185	248	125	98	20	6	5	-	1,343
Region X											
Alaska	2	1	-	-	-	-	-	-			3
Idaho	5	1	2	4	-	1	-	-	-	-	13
Oregon	29	8	11	14	6	2	-	-	-	-	70
Washington	45	15	14	26	6	3	-	-	-	-	109
Subtotal	81	25	27	44	12	6	-	-	-	-	195
Total	2,522	1,265	1,267	1,809	1,055	877	260	102	71	13	9,271

* U.S. Department of Commerce, 1976.

TABLE K-11
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 31 - LEATHER AND LEATHER PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	5	4	2	4	5	4	–	1	–	–	25
Maine	16	5	6	20	12	25	27	5	1	–	117
Massachusetts	92	52	47	79	44	45	25	5	2	–	391
New Hampshire	8	13	5	9	11	23	18	2	–		89
Rhode Island	7	1	3	10	–	3	–	1		–	25
Vermont	2	–	–	1	2	1	1	–	–	–	7
Subtotal	130	75	63	123	74	101	71	14	3	–	654
Region II											
Delaware	–	–	–	–	1	–	1	1	–	–	3
New Jersey	35	17	18	30	16	18	6	2	–	–	142
New York	204	132	118	168	99	71	25	3	–	–	820
Subtotal	239	149	136	198	116	89	32	6	–	–	965
Region III											
District of Columbia	–	–	–	–	–	–	–	–	–	–	–
Maryland	2	3	2	3	2	7	3	–	–	–	22
Pennsylvania	25	16	11	40	26	47	26	6	–	–	197
Virginia	5	–	2	2	1	6	8	–	–	–	24
West Virginia	2	1	1	1	2	2	4	–	–	–	13
Subtotal	34	20	16	46	31	62	41	6	–	–	256
Region IV											
Alabama	3	–	–	1	–	2	–	1	–	–	7
Florida	24	11	8	10	8	6	3	1	–	–	71
Georgia	6	1	4	4	2	3	8	1	–	–	29
Kentucky	3	–	3	2	–	7	7	2	–	–	24
Mississippi	4	1	1	1	–	–	3	2	–	–	12
North Carolina	16	5	7	4	2	5	4	1	–	–	44
South Carolina	2	2	2	1	1	–	–	–	–	–	8
Tennessee	16	3	2	12	10	8	28	10	–	–	89
Subtotal	74	23	27	35	23	31	53	18	–	–	284
Region V											
Illinois	31	12	17	14	16	18	12	–	1	–	121
Indiana	9	3	3	4	5	1	4	–	–	–	29
Michigan	10	2	3	4	–	4	6	1	–	–	30
Minnesota	4	4	–	4	4	2	3	1	–	–	22
Ohio	25	7	7	7	5	3	8	1	1	–	64
Wisconsin	13	11	9	15	15	28	14	6	–	–	111
Subtotal	92	39	39	48	45	56	47	9	2	–	377
Region VI											
Arkansas	1	1	1	1	1	9	14	3	–	–	31
Louisiana	4	3	–	1	–	1	–	–	–	–	9
New Mexico	–	2	–	–	5	–	–	–	–		7
Oklahoma	6	3	5	2	–	1	1	–	–	–	18
Texas	51	22	10	21	10	8	1	2	–	–	125
Subtotal	62	31	16	25	16	19	16	5	–	–	190
Region VII											
Iowa	3	1	5	4	4	2	–	–	–	–	19
Kansas	8	1	–	–	1	1	–	–	–	–	11
Missouri	18	6	9	13	22	22	35	7	–	–	132
Nebraska	1	1	–	2	–	–	–	–	–	–	4
Subtotal	30	9	14	19	27	25	35	7	–	–	166
Region VIII											
Colorado	8	5	2	3	2	–	–	–	1	–	21
Montana	1	–	–	–	–	–	–	–	–		1
North Dakota	1	–	–	–	–	–	–	–		5	6
South Dakota	1	–	1	–	–	1	–			–	3
Utah	1	–	2	2	–	–	–	–	–	–	5
Wyoming	1	–	–	–	–	–	–				1
Subtotal	13	5	5	5	2	1	–	–	1	5	37
Region IX											
Arizona	11	–	2	4	–	–	–	–	–	–	17
California	82	39	26	23	14	16	6	1	–	–	207
Hawaii	2	2	3	1	–	–	–	–		–	8
Nevada	–	–	–	–	–	–	–				–
Subtotal	95	41	31	28	14	16	6	1	–	–	232
Region X											
Alaska	–	–	–	–	–	–	–	–			–
Idaho	4	–	–	3	–	–	–	–	–	–	7
Oregon	14	4	2	4	–	–	–	–	–	–	24
Washington	4	3	4	2	–	1	–	–	–	–	14
Subtotal	22	7	6	9	–	1	–	–	–	–	45
Total	791	399	351	536	348	401	301	66	6	5	3,206

*U.S. Department of Commerce, 1976.

TABLE K-12
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 32 - STONE, CLAY, AND GLASS PRODUCTS*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	54	30	41	46	18	12	1	1	1	-	204
Maine	16	10	15	15	3	1	-	-	-	-	60
Massachusetts	96	55	72	50	22	14	2	1	1	1	314
New Hampshire	28	12	5	14	4	6	-	1	-	-	70
Rhode Island	19	10	8	8	4	-	1	2	-		52
Vermont	37	25	25	25	5	5	1	-	-	-	122
Subtotal	250	142	166	158	56	37	5	5	2	1	822
Region II											
Delaware	11	2	4	13	1	2	-	-	-	-	33
New Jersey	164	79	92	123	41	42	14	5	7	1	568
New York	319	189	179	144	66	41	16	9	1	1	965
Subtotal	494	270	275	280	108	85	30	14	8	2	1,566
Region III											
District of Columbia	2	-	2	-	1	1	-	-	-	-	6
Maryland	52	30	31	45	20	14	4	2	2	-	200
Pennsylvania	254	146	159	187	74	74	31	21	3	-	949
Virginia	55	44	60	70	30	22	2	1	-	-	284
West Virginia	50	18	19	31	21	20	11	7	4	-	181
Subtotal	413	238	271	333	146	131	48	31	9	0	1,620
Region IV											
Alabama	93	49	60	61	22	18	2	1	-	-	306
Florida	226	97	95	149	59	25	5	4	-	-	660
Georgia	113	76	82	108	31	28	6	3	1	-	448
Kentucky	80	38	43	48	7	12	5	4	-	-	237
Mississippi	39	29	30	34	14	20	1	1	-	-	168
North Carolina	115	72	55	84	32	26	4	3	1	-	392
South Carolina	40	23	30	31	15	11	2	3	2	-	157
Tennessee	98	50	48	64	26	19	1	6	2	1	315
Subtotal	804	434	443	579	206	159	26	25	6	1	2,683
Region V											
Illinois	235	150	157	144	49	33	23	7	4	1	803
Indiana	150	91	94	78	39	21	13	8	3	-	497
Michigan	239	131	135	131	36	17	6	6	2	-	703
Minnesota	119	82	72	46	29	5	3	-	-	-	356
Ohio	285	152	193	200	80	82	21	14	5	3	1,035
Wisconsin	157	88	84	67	12	7	4	1	-	-	420
Subtotal	1,185	694	735	666	245	165	70	36	14	4	3,814
Region VI											
Arkansas	73	34	36	26	8	10	2	-	-	-	189
Louisiana	70	44	34	35	24	8	6	-	-	-	221
New Mexico	28	18	16	15	1	3	-	-	-	-	81
Oklahoma	99	38	46	37	7	10	8	3	-	-	248
Texas	294	120	145	172	67	63	20	1		-	882
Subtotal	564	254	277	285	107	94	36	4	0	0	1,621
Region VII											
Iowa	129	76	52	41	11	13	2	-	-	-	324
Kansas	78	41	29	41	5	10	1	2	1	-	208
Missouri	134	79	74	65	15	24	3	2	2	-	398
Nebraska	55	27	23	27	6	3	1	-	-	-	142
Subtotal	396	223	178	174	37	50	7	4	3	-	1,072
Region VIII											
Colorado	88	36	33	33	15	9	1	-	1	-	218
Montana	32	21	16	7	4	1	-	-		-	81
North Dakota	30	12	8	11	2	2	-	-		-	65
South Dakota	32	11	9	11	2	1	-			-	66
Utah	36	12	17	17	12	6	-			-	100
Wyoming	20	9	6	10	5	-	-	-	-		50
Subtotal	238	101	89	89	40	19	1	-	1	-	580
Region IX											
Arizona	55	29	28	27	13	11	1	-	-	-	164
California	483	245	252	267	95	54	31	11	3	-	1,441
Hawaii	17	6	6	7	4	1	1	-		-	42
Nevada	16	7	7	15	4	4	-			-	53
Subtotal	571	287	293	316	116	70	33	11	3	-	1,700
Region X											
Alaska	11	5	6	1	1	-	-	-			24
Idaho	31	11	16	12	3	1	-	-	-	-	74
Oregon	77	46	44	23	4	8	1	-	-	-	203
Washington	99	45	40	36	17	7	-	2	-	-	246
Subtotal	218	107	106	72	25	16	1	2	-	-	547
Total	5,131	2,750	2,833	2,952	1,086	826	259	132	46	8	16,025

*U.S. Department of Commerce, 1976.

TABLE K-13
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 33 - PRIMARY METAL INDUSTRIES *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	40	21	31	38	26	24	15	8	3	-	206
Maine	4	1	2	3	1	1	1	-	-	-	13
Massachusetts	40	38	38	50	27	23	12	3	-	-	231
New Hampshire	4	1	6	8	5	2	3	1	-		30
Rhode Island	28	19	11	21	7	6	7	2		2	103
Vermont	3	-	-	3	1	1	2	-	-	-	10
Subtotal	119	80	88	123	67	57	40	14	3	2	593
Region II											
Delaware	1	-	1	1	2	4	-	-	1	-	10
New Jersey	64	44	43	56	47	43	22	7	4	-	330
New York	101	69	74	93	41	51	20	17	6	1	473
Subtotal	166	113	118	150	90	98	42	24	11	1	813
Region III											
District of Columbia	-	-	-	-	-	-	-	-	-	-	-
Maryland	15	6	9	5	4	9	2	7	4	1	57
Pennsylvania	91	61	72	100	68	85	55	26	16	20	594
Virginia	2	2	9	8	6	9	3	2	2	-	43
West Virginia	6	5	4	6	4	7	2	4	3	1	42
Subtotal	114	74	94	119	82	110	62	34	25	22	736
Region IV											
Alabama	16	14	8	26	14	26	18	9	5	4	140
Florida	29	10	13	19	9	12	2	-	-	-	94
Georgia	11	7	9	16	9	12	5	-	4	-	73
Kentucky	12	5	1	8	10	12	12	5	1	1	67
Mississippi	3	-	2	3	8	7	2	-	-	-	25
North Carolina	12	7	10	14	9	11	3	2	1	-	69
South Carolina	9	3	1	10	4	5	3	1	-	-	36
Tennessee	16	7	8	19	18	14	13	3	2	1	101
Subtotal	108	53	52	115	81	99	58	20	13	6	605
Region V											
Illinois	88	55	73	131	79	81	29	14	8	11	569
Indiana	43	24	37	48	38	37	21	12	13	4	277
Michigan	104	54	82	131	65	52	30	18	7	7	550
Minnesota	22	12	21	21	18	11	4	2	-	-	111
Ohio	101	60	87	126	86	92	48	24	16	13	653
Wisconsin	31	22	26	50	33	30	19	11	2	-	224
Subtotal	389	227	326	507	319	303	151	81	46	35	2,384
Region VI											
Arkansas	5	-	-	4	1	17	4	2	-	-	33
Louisiana	5	-	4	5	4	4	3	1	2	-	28
New Mexico	4	-	-	1	2	1	-	-	-		8
Oklahoma	11	4	2	16	6	9	2	2	-	-	52
Texas	55	33	31	53	32	18	15	6	5	2	250
Subtotal	80	37	37	79	45	49	24	11	7	2	371
Region VII											
Iowa	5	11	7	12	13	11	4	1	-	1	65
Kansas	8	3	5	17	7	7	-	-	-	-	47
Missouri	21	10	19	15	20	25	8	4	-	-	123
Nebraska	3	4	1	4	2	2	2	-	1	-	19
Subtotal	37	28	32	48	42	45	14	5	1	2	254
Region VIII											
Colorado	19	9	10	10	6	3	1	-	-	1	59
Montana	2	-	1	2	1	2	-	3		1	12
North Dakota	1	-	-	2	-	-	-	-			3
South Dakota	-	-	-	-	-	-	-			-	-
Utah	8	4	4	4	6	-	2	1	1	1	31
Wyoming	1	-	-	-	-	-	-				1
Subtotal	31	13	15	18	13	5	3	4	1	3	106
Region IX											
Arizona	14	3	3	6	8	3	5	4	1	-	47
California	157	90	117	157	93	74	17	7	3	2	717
Hawaii	1	1	-	-	-	1	-	-	-	-	3
Nevada	5	-	1	-	1	-	2				9
Subtotal	177	94	121	163	102	78	24	11	4	2	776
Region X											
Alaska	-	-	-	-	-	-	-	-	-	-	-
Idaho	3	1	2	1	-	-	1	1	-	-	9
Oregon	14	9	5	9	9	10	4	1	2	-	63
Washington	20	7	11	15	9	9	5	6	3	-	85
Subtotal	37	17	18	25	18	19	10	8	5	-	157
Total	1,258	736	901	1,347	859	863	428	212	116	75	6,795

*U.S. Department of Commerce, 1976.

TABLE K-14
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 34 - FABRICATED METAL PRODUCTS *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	260	145	165	193	81	67	16	11	10	-	948
Maine	25	13	8	12	3	4	1	1	-	-	67
Massachusetts	332	194	195	232	92	58	19	11	3	-	1,136
New Hampshire	28	18	16	17	6	9	2	-	-		96
Rhode Island	134	80	44	66	22	15	3	1	-		365
Vermont	13	8	5	4	-	1	-	-	1	-	32
Subtotal	792	458	433	524	204	154	41	24	14	0	2,644
Region II											
Delaware	10	6	8	9	4	1	1	-	-	-	39
New Jersey	427	274	285	291	132	84	28	5	5	1	1,532
New York	803	491	465	455	211	131	39	12	5	1	2,613
Subtotal	1,240	771	758	755	347	216	68	17	10	2	4,184
Region III											
District of Columbia	8	4	3	1	2	1	-	-	-	-	19
Maryland	75	45	46	65	25	26	6	3	1	-	292
Pennsylvania	476	254	285	375	211	131	65	25	9	1	1,832
Virginia	66	18	42	47	30	24	11	-	0	-	238
West Virginia	26	12	11	19	14	13	6	2	1	-	104
Subtotal	651	333	387	507	282	195	88	30	11	1	2,485
Region IV											
Alabama	89	52	42	60	36	33	16	4	1	-	333
Florida	295	140	135	133	73	47	11	4	-	-	838
Georgia	110	46	53	86	35	36	10	5	-	-	381
Kentucky	66	32	32	50	31	30	15	3	1	-	260
Mississippi	27	8	23	29	18	18	8	1	1	-	133
North Carolina	106	47	52	77	41	33	9	3	-	-	368
South Carolina	51	28	13	38	17	13	6	2	-	-	168
Tennessee	141	49	47	80	36	37	16	7	2	1	416
Subtotal	885	402	397	553	287	247	91	29	5	1	2,897
Region V											
Illinois	1,197	536	531	444	180	159	66	38	24	9	3,184
Indiana	191	106	106	199	83	78	42	15	3	3	826
Michigan	522	367	413	504	223	166	48	11	2	11	2,267
Minnesota	129	62	75	102	59	30	9	6	2	2	476
Ohio	513	295	327	477	257	189	65	39	9	7	2,178
Wisconsin	210	108	120	127	62	56	26	13	6	2	730
Subtotal	2,762	1,474	1,572	1,853	864	678	256	122	46	34	9,661
Region VI											
Arkansas	49	14	25	25	15	18	10	3	-	-	159
Louisiana	70	26	33	30	23	12	2	2	2	1	201
New Mexico	23	7	6	4	5	2	-	-	-		47
Oklahoma	128	45	37	66	21	19	8	3	1	-	328
Texas	485	199	202	275	120	112	35	10	4	1	1,443
Subtotal	755	291	303	400	184	163	55	18	7	2	2,178
Region VII											
Iowa	63	41	33	41	21	25	8	4	1	1	238
Kansas	66	34	34	49	27	18	1	-	1	-	230
Missouri	159	78	109	123	40	35	19	9	-	2	574
Nebraska	34	14	13	21	10	10	2	3	1	-	108
Subtotal	322	167	189	234	98	88	30	16	3	3	1,150
Region VIII											
Colorado	91	37	29	46	20	13	2	2	1	1	242
Montana	13	4	2	6	3	-	-	-		-	28
North Dakota	7	3	5	4	-	1	-	-			20
South Dakota	51	28	13	38	17	13	6	2	-	-	168
Utah	35	16	24	24	14	4	2	-	-	-	119
Wyoming	5	2	1	3	-	-	-				11
Subtotal	202	90	74	121	54	31	10	4	1	1	588
Region IX											
Arizona	52	37	28	36	7	2	4	-	-	-	166
California	1,160	613	642	669	263	176	52	17	6	-	3,598
Hawaii	15	6	2	7	2	-	1	-		-	33
Nevada	9	6	4	6	1	1	-				-
Subtotal	1,236	662	676	718	273	179	57	17	6	0	3,824
Region X											
Alaska	4	4	1	-	-	-	-	-			9
Idaho	15	5	7	14	4	-	1	-	-	-	46
Oregon	106	37	41	58	26	14	3	1	-	-	286
Washington	135	55	61	57	27	8	4	-	-	-	347
Subtotal	260	101	110	129	57	22	8	1	0	0	688
Total	9,105	4,749	4,899	5,794	2,650	1,973	704	278	103	44	30,299

*U.S. Department of Commerce, 1976.

TABLE K-15
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 35 - MACHINERY EXCEPT ELECTRICAL*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	504	232	196	158	48	33	23	13	5	3	1,235
Maine	36	16	9	9	7	5	-	1	-	-	83
Massachusetts	595	280	228	212	99	56	22	19	12	2	1,525
New Hampshire	57	27	24	18	18	6	5	5	1		161
Rhode Island	120	55	41	29	5	12	2	1	2		267
Vermont	26	11	6	10	3	4	6	2	-	-	68
Subtotal	1,338	641	504	436	180	116	58	41	20	5	3,339
Region II											
Delaware	24	8	11	7	1	1	-	1	1	-	54
New Jersey	831	377	344	269	87	55	30	12	7	1	2,013
New York	1,202	546	442	353	140	78	32	22	16	9	2,840
Subtotal	2,057	921	797	629	228	134	62	35	24	10	4,907
Region III											
District of Columbia	3	2	3	3	1	-	-	-	-	-	12
Maryland	135	40	37	45	20	12	7	5	1	2	304
Pennsylvania	855	354	366	322	139	114	44	26	13	5	2,238
Virginia	139	42	48	43	23	14	6	1	1	-	317
West Virginia	64	34	22	25	15	5	1	2	-	-	168
Subtotal	1,196	472	476	438	198	145	58	34	15	7	3,039
Region IV											
Alabama	155	64	50	35	14	14	6	2	-	-	340
Florida	450	139	113	111	32	16	6	2	2	-	871
Georgia	217	71	85	57	24	25	3	3	2	1	488
Kentucky	119	41	58	39	22	15	11	6	1	4	316
Mississippi	66	25	28	15	10	10	4	6	-	-	164
North Carolina	247	114	102	80	45	29	17	8	2	1	645
South Carolina	125	30	35	36	17	22	11	5	4	-	285
Tennessee	184	71	79	75	20	20	12	6	5	1	473
Subtotal	1,563	555	550	448	184	151	70	38	16	7	3,582
Region V											
Illinois	1,197	536	531	444	180	159	66	38	24	9	3,184
Indiana	471	201	197	178	83	54	29	21	7	1	1,242
Michigan	1,217	690	748	635	185	148	40	25	13	3	3,704
Minnesota	335	140	109	138	56	58	21	11	6	3	877
Ohio	1,290	517	578	445	202	168	71	45	25	6	3,347
Wisconsin	411	195	212	219	95	62	33	26	15	5	1,273
Subtotal	4,921	2,279	2,375	2,059	801	649	260	166	90	27	13,627
Region VI											
Arkansas	113	31	24	26	7	10	5	3	-	-	219
Louisiana	121	48	53	43	11	13	3	1	-	-	293
New Mexico	57	16	22	11	2	-	-	1	-		109
Oklahoma	232	59	74	49	27	27	10	5	4	-	487
Texas	887	331	282	245	92	74	38	11	7	2	1,969
Subtotal	1,410	485	455	374	139	124	56	21	11	2	3,077
Region VII											
Iowa	165	63	72	78	40	40	13	7	7	2	487
Kansas	211	63	50	58	31	21	9	3	3	-	451
Missouri	321	154	104	103	49	28	10	4	7	-	780
Nebraska	86	35	27	24	18	6	3	3	1	-	203
Subtotal	783	315	253	203	140	95	35	17	18	2	1,921
Region VIII											
Colorado	152	68	42	39	18	17	4	3	1	1	345
Montana	29	5	2	6	-	-	-	-	-	-	42
North Dakota	22	12	10	4	4	2	-	1			55
South Dakota	25	5	1	9	4	3	3			-	50
Utah	62	16	20	10	10	3	4	-	2	-	127
Wyoming	17	9	5	-	1	2	1	-			35
Subtotal	307	115	80	68	37	27	12	4	3	1	654
Region IX											
Arizona	123	46	38	32	14	2	4	2	-	1	264
California	2,524	950	820	615	211	130	44	24	8	4	5,330
Hawaii	14	6	5	1	1	1	-	-	-	-	28
Nevada	28	4	1	5	3	1	-				42
Subtotal	2,689	1,008	864	653	229	134	48	26	8	5	5,664
Region X											
Alaska	11	6	3	1	-	-	-	-	-	-	21
Idaho	54	15	3	10	4	-	-	-	-	-	86
Oregon	184	73	58	54	24	13	4	2	1	-	413
Washington	228	81	57	57	24	9	6	3			465
Subtotal	477	175	121	122	52	22	10	5	1	-	985
Total	16,741	6,976	6,475	5,490	2,188	1,597	669	387	206	66	40,795

*U.S. Department of Commerce, 1976.

TABLE K-16
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 36 - ELECTRIC AND ELECTRONIC EQUIPMENT*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-over)	Total
Region I											
Connecticut	95	39	51	67	42	39	18	16	6	1	374
Maine	4	2	1	4	1	5	5	1	2	-	25
Massachusetts	158	71	76	127	76	57	33	15	9	5	627
New Hampshire	18	14	4	10	6	8	6	5	2		73
Rhode Island	12	4	13	12	6	7	3	2	2		61
Vermont	5	2	-	1	1	2	1	2	-	1	15
Subtotal	292	132	145	221	132	118	66	41	21	7	1,175
Region II											
Delaware	3	2	1	4	2	-	2	-	-	-	14
New Jersey	238	119	111	160	89	82	37	16	11	6	869
New York	479	221	210	249	146	138	53	32	17	13	1,558
Subtotal	720	342	322	413	237	220	92	48	28	19	2,441
Region III											
District of Columbia	2	3	1	1	-	1	1	-	-	-	9
Maryland	31	22	18	25	14	14	7	5	3	3	142
Pennsylvania	174	71	74	100	97	78	50	28	20	8	700
Virginia	31	21	12	13	5	21	11	5	6	2	127
West Virginia	11	4	1	1	2	7	3	2	1	-	32
Subtotal	249	121	106	140	118	121	72	40	30	13	1,010
Region IV											
Alabama	22	7	9	11	10	8	2	5	2	1	79
Florida	127	48	39	52	29	29	15	12	3	2	356
Georgia	36	14	12	14	8	10	10	1	4	-	109
Kentucky	18	6	4	12	7	14	7	15	2	4	89
Mississippi	9	2	1	5	6	11	10	7	3	-	54
North Carolina	36	16	10	14	11	16	17	15	5	2	142
South Carolina	7	3	2	7	4	9	12	5	2	-	51
Tennessee	60	14	19	21	9	19	19	13	7	1	182
Subtotal	315	110	96	138	84	116	92	73	28	10	1,062
Region V											
Illinois	218	112	116	169	125	105	55	32	24	12	968
Indiana	67	22	24	39	20	51	16	21	11	11	282
Michigan	123	62	54	75	47	35	11	5	5	3	420
Minnesota	53	33	18	29	26	20	13	5	3	-	200
Ohio	147	48	66	84	67	72	41	18	26	5	574
Wisconsin	58	26	23	42	32	37	19	14	7	2	260
Subtotal	666	303	301	438	317	320	155	95	76	33	2,704
Region VI											
Arkansas	14	4	2	9	4	14	6	8	4	-	65
Louisiana	16	10	4	7	2	1	3	1	-	1	45
New Mexico	13	7	4	5	3	4	1	2	-		39
Oklahoma	27	12	11	15	7	8	4	1	-	1	86
Texas	189	49	62	79	35	36	17	7	4	1	481
Subtotal	259	82	83	115	51	63	31	19	8	3	716
Region VII											
Iowa	14	8	2	8	7	9	7	3	1	2	61
Kansas	24	7	9	15	2	5	3	-	1	-	66
Missouri	48	15	15	32	23	24	18	11	5	2	191
Nebraska	8	4	7	6	6	6	2	3	-	1	43
Subtotal	94	34	33	61	38	44	30	17	7	5	361
Region VIII											
Colorado	44	19	16	14	11	6	1	-	1	1	113
Montana	2	1	1	2	-	-	-	-	-	-	6
North Dakota	1	-	1	-	1	-	-	-			3
South Dakota	2	1	-	-	-	1	2			-	6
Utah	18	8	5	5	1	1	3	-	1	-	46
Wyoming	1	1	-	-	-	-	-				2
Subtotal	68	30	23	21	13	10	6	-	2	1	176
Region IX											
Arizona	37	13	16	13	4	12	1	3	1	3	103
California	725	326	312	365	218	174	77	33	20	8	2,258
Hawaii	7	2	-	-	-	-	-	-	-	-	9
Nevada	7	3	2	5	-	2	1				20
Subtotal	776	344	330	383	222	188	79	36	21	11	2,390
Region X											
Alaska	2	-	-	-	-	-	-	-	-	-	2
Idaho	4	2	-	-	-	1	1	-	-	-	8
Oregon	33	22	7	18	9	7	1	1	-	-	98
Washington	58	22	12	18	7	1	1	2	-	-	121
Subtotal	97	46	19	36	16	11	3	3	0	0	231
Total	3,536	1,544	1,458	1,966	1,230	1,211	676	372	221	104	12,268

*U.S. Department of Commerce, 1976.

TABLE K-17
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 37 - TRANSPORTATION EQUIPMENT *

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	42	20	20	26	14	13	4	3	5	7	154
Maine	33	12	9	9	3	1	1	-	-	1	69
Massachusetts	61	33	20	35	14	6	4	-	3	3	179
New Hampshire	7	4	3	3	-	-	2	1	-		20
Rhode Island	14	4	2	10	3	2	2	-	-		37
Vermont	3	-	-	2	1	-	1	1	-	-	8
Subtotal	160	73	54	85	35	22	14	5	8	11	467
Region II											
Delaware	7	1	1	1	1	2	-	-	-	2	15
New Jersey	82	38	27	37	17	22	4	5	-	4	236
New York	146	60	53	63	37	32	10	7	4	6	418
Subtotal	235	99	81	101	55	56	14	12	4	12	669
Region III											
District of Columbia	-	-	1	-	-	-	-	-	-	-	1
Maryland	51	12	14	8	11	3	2	3	3	2	109
Pennsylvania	72	39	35	51	29	30	15	13	10	6	300
Virginia	48	14	15	8	9	8	7	-	2	1	112
West Virginia	6	3	3	7	4	-	-	1	1	-	25
Subtotal	177	68	68	74	53	41	24	17	16	9	547
Region IV											
Alabama	36	19	11	15	14	14	7	6	3	1	126
Florida	236	76	72	80	42	29	13	8	4	2	562
Georgia	46	19	26	30	15	6	6	4	-	4	156
Kentucky	19	13	4	7	8	10	4	1	2	1	69
Mississippi	12	4	12	12	12	4	2	-	2	1	61
North Carolina	54	12	14	17	6	12	8	1	1	-	125
South Carolina	17	8	6	20	5	4	2	2	-	-	64
Tennessee	51	21	15	23	12	16	5	11	3	2	159
Subtotal	471	172	160	204	114	95	47	33	15	11	1,322
Region V											
Illinois	73	30	40	48	71	31	22	8	5	3	281
Indiana	95	43	50	63	51	38	37	13	6	11	407
Michigan	155	60	60	96	60	51	29	21	20	36	588
Minnesota	62	22	18	25	9	7	4	3	2	-	152
Ohio	117	38	35	74	52	51	21	23	15	19	445
Wisconsin	50	23	13	24	22	15	5	3	1	5	163
Subtotal	552	216	216	330	215	193	118	71	49	74	2,034
Region VI											
Arkansas	31	14	13	15	4	7	6	1	1	-	92
Louisiana	59	18	21	27	13	13	13	6	1	1	171
New Mexico	14	4	2	2	4	-	-	-	1		27
Oklahoma	56	15	24	22	12	8	2	2	1	-	139
Texas	207	73	72	77	51	34	19	6	6	4	549
Subtotal	365	124	132	143	84	60	39	15	11	5	978
Region VII											
Iowa	28	11	13	17	9	12	4	-	-	1	95
Kansas	49	19	21	27	18	11	3	3	-	5	155
Missouri	64	23	21	27	18	16	8	4	4	8	193
Nebraska	15	5	2	6	4	2	-	4	-	-	38
Subtotal	156	58	57	77	49	41	14	11	4	14	481
Region VIII											
Colorado	32	12	11	13	5	6	3	2	-	1	86
Montana	14	4	5	2	1	-	-	-	-		23
North Dakota	6	2	1	1	-	1	-	-			11
South Dakota	10	4	6	1	1	-	-			-	22
Utah	22	8	9	3	1	6	3	-	2	-	57
Wyoming	1	2	1	2	-	-	-				8
Subtotal	86	37	28	26	10	13	3	2	2	1	207
Region IX											
Arizona	33	18	13	16	6	5	-	-	-	2	93
California	556	203	204	228	148	113	41	19	18	22	1,544
Hawaii	1	1	2	-	1	1	-	-		-	6
Nevada	2	5	1	-	1	-	-				10
Subtotal	594	225	222	244	156	121	41	19	18	24	1,655
Region X											
Alaska	7	4	1	1	-	-	-		-	-	13
Idaho	23	6	3	3	1	-	1	1	-	-	36
Oregon	72	16	22	21	17	8	6	1	1	-	159
Washington	105	27	32	35	11	14	8	1	4	3	240
Subtotal	207	53	58	67	29	22	15	3	5	3	448
Total	2,999	1,119	1,008	1,166	795	662	331	188	132	164	8,866

*U.S. Department of Commerce, 1976.

TABLE K-18
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 38 - INSTRUMENTS AND RELATED PRODUCTS*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	43	27	18	33	14	24	13	7	2	-	181
Maine	5	3	-	2	1	1	-	-	-	-	12
Massachusetts	109	66	44	56	22	20	13	9	5	2	346
New Hampshire	14	2	4	6	4	4	4	-	1		39
Rhode Island	9	3	5	4	3	4	3	1	2		34
Vermont	6	-	2	3	1	1	1	1	-	-	15
Subtotal	186	101	73	104	45	54	34	18	10	2	627
Region II											
Delaware	8	1	2	1	-	-	3	-	-	-	15
New Jersey	124	56	59	62	39	26	6	7	4	-	383
New York	283	148	115	119	64	67	20	7	8	4	835
Subtotal	415	205	176	182	103	93	29	14	12	4	1233
Region III											
District of Columbia	5	2	-	2	-	-	-	-	-	-	9
Maryland	34	13	13	14	6	3	4	-	-	-	87
Pennsylvania	118	51	59	58	30	24	15	6	6	2	369
Virginia	20	15	2	10	4	5	1	-	-	-	57
West Virginia	7	4	1	1	1	2	1	-	-	-	17
Subtotal	184	85	75	85	41	34	21	6	6	2	539
Region IV											
Alabama	15	7	2	6	2	3	-	1	-	-	36
Florida	71	29	21	14	8	8	2	3	-	-	156
Georgia	22	4	11	7	3	1	2	-	1	-	51
Kentucky	12	7	-	1	2	2	5	3	-	-	32
Mississippi	6	2	-	1	1	2	-	-	1	-	13
North Carolina	22	6	9	8	-	4	7	4	1	-	61
South Carolina	6	-	4	-	3	3	1	3	-	-	20
Tennessee	19	8	4	3	5	3	3	1	-	-	46
Subtotal	173	63	51	40	24	26	20	15	3	-	415
Region V											
Illinois	138	61	61	58	36	31	12	13	8	2	420
Indiana	38	13	17	13	7	12	6	5	-	-	111
Michigan	68	39	22	31	13	18	5	-	1	-	197
Minnesota	46	15	12	18	2	9	1	3	-	1	107
Ohio	98	36	42	51	26	23	8	6	3	-	293
Wisconsin	33	12	10	11	11	6	2	5	1	-	91
Subtotal	421	176	164	182	95	99	34	32	13	3	1219
Region VI											
Arkansas	3	1	2	-	2	2	-	1	-	1	14
Louisiana	12	3	5	4	1	1	-	-	-	-	26
New Mexico	5	3	-	1	-	3	-	-	-		12
Oklahoma	29	9	2	11	-	3	-	-	-	-	54
Texas	103	33	40	33	17	10	3	1	2	-	242
Subtotal	152	51	49	49	20	19	3	2	2	1	348
Region VII											
Iowa	24	4	4	5	1	3	1	2	-	-	44
Kansas	20	5	5	8	2	2	-	-	-	-	42
Missouri	32	12	11	20	3	11	3	1	-	-	93
Nebraska	10	2	6	2	-	3	2	2	-	-	27
Subtotal	86	23	26	35	6	19	6	5	-	-	206
Region VIII											
Colorado	31	9	10	7	6	4	2	1	4	-	74
Montana	5	2	-	2	-	-	-	-	-	-	9
North Dakota	4	1	-	-	-	-	-	-			5
South Dakota	2	-	-	-	-	1	1			-	4
Utah	17	6	7	2	1	-	-	-	-	-	33
Wyoming	3	-	-	-	2	-	-				5
Subtotal	62	18	17	11	9	5	3	1	4	-	130
Region IX											
Arizona	22	7	4	6	2	3	-	-	1	-	45
California	421	171	156	163	76	58	21	9	7	1	·1,083
Hawaii	1	2	2	-	1	-	-	-	-	-	6
Nevada	3	-	-	-	1	1	-				5
Subtotal	447	180	162	169	80	62	21	9	8	1	1,139
Region X											
Alaska	2	-	1	-	-	-	-	-	-	-	3
Idaho	4	1	1	-	-	-	-	-	-	-	6
Oregon	21	13	5	8	5	4	-	-	1	1	58
Washington	25	17	3	12	2	2	-	3	-	-	66
Subtotal	52	31	12	20	7	6	0	3	1	1	133
Total	2,178	933	805	877	430	417	171	105	59	14	5,989

*U.S. Department of Commerce, 1976.

TABLE K-19
UNITED STATES DISTRIBUTION OF MANUFACTURING FIRMS BY SIZE FOR STANDARD INDUSTRIAL CLASSIFICATION 39 - MISCELLANEOUS MANUFACTURING INDUSTRIES*

State	Size of Firm										
	(1-4)	(5-9)	(10-19)	(20-49)	(50-99)	(100-249)	(250-499)	(500-999)	(1000-2499)	(2500-Over)	Total
Region I											
Connecticut	81	34	38	47	15	17	12	5	-	-	249
Maine	31	10	5	6	1	1	1	-	-	-	55
Massachusetts	206	99	78	88	46	37	11	4	3	-	574
New Hampshire	26	6	6	5	3	4	2	-	-		52
Rhode Island	352	142	91	111	57	34	15	6	1		809
Vermont	15	8	1	6	5	2	-	-	-	-	37
Subtotal	711	299	219	263	127	95	41	15	6	-	1,776
Region II											
Delaware	12	6	5	-	-	-	-	-	-	-	23
New Jersey	244	129	102	114	58	44	9	7	2	-	709
New York	1,305	757	574	498	204	103	28	2	4	-	3,475
Subtotal	1,561	892	681	612	262	147	37	9	6	-	4,207
Region III											
District of Columbia	9	3	4	1	1	1	-	-	-	-	15
Maryland	53	25	15	18	11	6	1	-	-	-	129
Pennsylvania	277	115	75	85	44	31	16	7	3	1	654
Virginia	52	24	15	14	9	3	1	1	1	-	120
West Virginia	27	3	4	6	1	3	-	-	1	-	45
Subtotal	418	170	113	124	66	44	18	8	5	1	967
Region IV											
Alabama	50	12	20	11	5	7	2	1	-	-	108
Florida	337	95	58	38	15	7	3	-	-	-	553
Georgia	89	30	23	21	6	5	5	2	1	-	182
Kentucky	41	16	11	16	8	9	3	1	-	-	105
Mississippi	25	6	10	8	1	-	5	2	1	-	58
North Carolina	101	32	22	20	10	13	2	2	-	-	202
South Carolina	32	11	9	5	4	5	6	2	-	-	74
Tennessee	94	33	22	32	18	19	9	2	-	-	229
Subtotal	769	235	175	151	67	65	35	12	2	-	1,511
Region V											
Illinois	286	137	101	123	67	56	21	6	4	-	801
Indiana	129	39	33	33	15	11	4	4	-	-	268
Michigan	214	80	61	42	15	14	4	1	1	-	432
Minnesota	93	39	32	32	14	15	5	1	1	-	232
Ohio	240	99	79	79	31	35	12	-	1	-	576
Wisconsin	142	45	36	40	31	15	6	1	2	-	318
Subtotal	1,104	439	342	349	173	146	52	13	9	-	2,627
Region VI											
Arkansas	36	10	10	10	4	8	4	2	-	-	84
Louisiana	50	17	13	9	1	4	1	-	-	-	95
New Mexico	43	9	7	4	2	-	1	-	-		66
Oklahoma	67	25	14	11	-	1	-	1	-	-	121
Texas	292	99	79	61	31	15	5	-	-	-	582
Subtotal	488	160	123	95	38	30	11	3	-	-	948
Region VII											
Iowa	60	21	19	20	11	4	5	2	-	-	142
Kansas	43	21	14	4	2	4	1	-	-	-	89
Missouri	114	43	43	42	26	15	3	-	-	-	286
Nebraska	33	10	12	9	-	2	-	1	-	-	67
Subtotal	250	95	88	75	39	25	9	3	-	-	584
Region VIII											
Colorado	82	34	20	16	9	2	3	-	-	-	166
Montana	17	8	1	2	1	1	-	-	-		30
North Dakota	10	3	2	2	1	1	-	-			19
South Dakota	10	7	1	3	-	-	-			-	21
Utah	35	17	5	6	1	-	3	-	-	-	67
Wyoming	13	4	2	-	-	-	-				19
Subtotal	167	73	31	29	12	4	6	-	-	-	322
Region IX											
Arizona	48	20	15	9	3	4	-	-	-	-	99
California	784	314	240	188	72	36	9	7	-	1	1,651
Hawaii	25	12	9	5	3	-	1	-		-	55
Nevada	18	4	11	5	-	-	-				38
Subtotal	875	350	275	207	78	40	10	7	-	1	1,843
Region X											
Alaska	6	1	2	-	-	-	-	-	-	-	9
Idaho	19	7	3	2	1	-	-	-	-	-	32
Oregon	65	28	15	18	4	6	-	-	-	-	136
Washington	114	44	25	27	9	3	1	-	-	-	223
Subtotal	204	80	45	47	14	9	1	-	-	-	400
Total	6,547	2,791	2,092	1,952	876	605	220	78	28	2	15,185

*U.S. Department of Commerce, 1976.

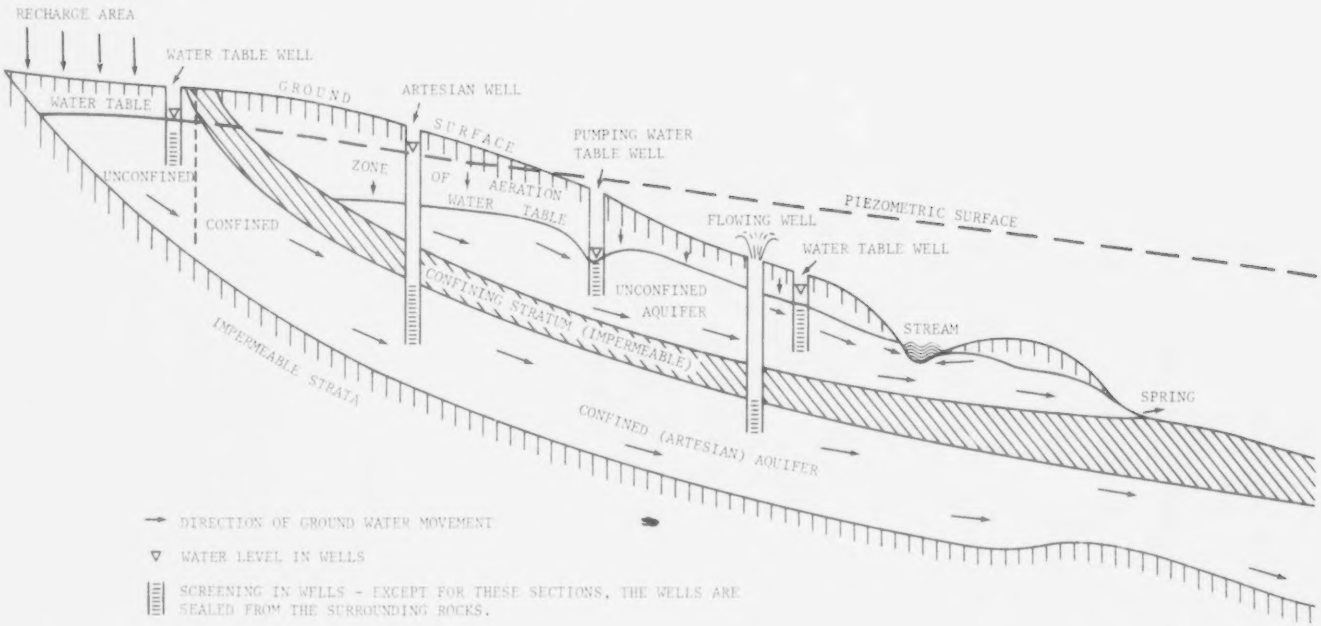
APPENDIX L

BACKGROUND INFORMATION ON GROUNDWATER MOVEMENT AND CONTAMINATION

L.1 Occurrence and Movement of Groundwater

The primary source of groundwater is percolating rainfall which infiltrates through void spaces between soil particles and within bedrock. As water infiltrates through the soil, it first passes through the zone of aeration in which the void spaces are partially filled by water held to soil particles by weak molecular bonding and surface tension. It is in this zone that most of the processes which comprise "natural filtering" occur. The remaining water continues downward to the zone of saturation, where all void spaces are filled with water. If the zone of saturation is sufficiently permeable to yield economically significant amounts of groundwater, the formation is considered to be an aquifer (Gary et al., 1972). Permeability is defined as the capacity of porous rock, sediments, or soil for transmitting fluids (Gary et al., 1972). Aquifers may be composed of either unconsolidated sediments, such as sand and gravel, or of porous or fractured bedrock.

There are two major types of aquifers: unconfined or water table aquifers and confined or artesian aquifers, as illustrated in Figure L-1. Unconfined aquifers are generally shallow, and have no continuous impermeable layers separating them from the ground surface. The water is, therefore, under atmospheric pressure and is free to rise and fall with changes in the volume of stored water.


RECHARGE AREA
WATER TABLE WELL
GROUND SURFACE
ARTESIAN WELL
WATER TABLE
PUMPING WATER TABLE WELL
UNCONFINED
ZONE OF AERATION
WATER TABLE
PIEZOMETRIC SURFACE
CONFINED
FLOWING WELL
WATER TABLE WELL
UNCONFINED AQUIFER
CONFINING STRATUM (IMPERMEABLE)
STREAM
IMPERMEABLE STRATA
SPRING
CONFINED (ARTESIAN) AQUIFER
→ DIRECTION OF GROUND WATER MOVEMENT
▽ WATER LEVEL IN WELLS
SCREENING IN WELLS - EXCEPT FOR THESE SECTIONS, THE WELLS ARE SEALED FROM THE SURROUNDING ROCKS.

SOURCE: MODIFIED FROM TODD, 1959.

FIGURE L-1
UNCONFINED AND CONFINED AQUIFERS

Since the recharge area for an unconfined aquifer is the entire land surface above it, it is quite susceptible to pollution from landfill leaching and from spills. Figure L-1 also illustrates the water table effects of a pumping well and a stream being supplied by groundwater.

An artesian aquifer, on the other hand, is a completely saturated formation bounded above and below by layers of relatively impermeable materials. These aquifers receive recharge in one or more areas where the formation outcrops on the surface or is hydraulically connected to an unconfined aquifer. (In their recharge areas all aquifers are unconfined and are equally susceptible to pollution by contaminated waters percolating down from the ground surface.) The water in the confined or artesian section of the aquifer is at a pressure related to the elevation of the water table in its recharge area. This pressure is usually discussed in terms of the piezometric surface (also called the potentiometric surface), which may be determined by the water levels in nonpumping wells open only to the artesian aquifer. Where the piezometric surface is above the ground level, artesian wells will flow.

A close relationship exists between surface water and groundwater in unconfined aquifers. During periods of peak runoff when stream flow and lake stages are at high levels, surface water bodies often act as recharge areas for groundwater, while during periods of low flow the surface water bodies may be entirely supported by groundwater discharges. As a result, the travel of contaminants in water may be in either direction--into surface waters or into groundwaters, depending on the relative height of the groundwater table as compared to the surface water level. Thus, the direction of flow varies as a function of seasonal rainfall, occurrence of droughts, and local groundwater pumping.

Groundwater movement is governed by gravity as modified by the structural characteristics and variations in permeability of the aquifer in the zone of aeration. In permeable materials above unconfined aquifers, water generally percolates straight down to the water table. If the surface of the water table were horizontal and there were no pumping wells, the water would remain essentially in place. However, due to factors such as sloping ground surface, variations in the permeability of overlying materials, and differential recharge, water tables usually have at least a slight slope, causing groundwater to move down gradient (along the slope) to eventually discharge in a spring or stream. Pumping wells also cause groundwater to move by creating a cone of depression in the water table.

Rates of groundwater movement are influenced by the size of the voids in earth materials and the degree to which the voids are interconnected. The permeability coefficient is the rate of flow of water in gallons per day through a cross section of 1 square foot under a unit hydraulic gradient at a standard temperature (Gary et al. 1972). Good aquifers generally have permeabilities in excess of 10 gallons per day per square foot (Todd, 1959). The rate of groundwater movement is governed by the permeability of the aquifer material and the hydraulic gradient (a function of the slope of the water table or piezometric surface defined as the rate of change of pressure head per unit distance of flow (Gary et al., 1972)). Normal groundwater velocities range from 5 feet per year to 5 feet per day, though much higher rates have also been measured (Todd, 1959). It is apparent that any groundwater contamination occurring in aquifers exhibiting flows of even hundreds of feet per year might not be detected for several years, by which time significant and possibly irreversible damage may have occurred.

Sands and gravels generally have high coefficients of permeability due to the large and well connected openings between individual particles. Such deposits transmit water readily and are therefore not generally suitable for landfills. Silts and clays, on the other hand, generally have very low permeabilities. The permeability of bedrock varies with the grain size, degree of cementation, and densities of fractures or joints. In general, sandstones are the most permeable rock types, though some sandstones are so fine grained and well cemented that their permeabilities are negligible. Some volcanic materials are also highly permeable. Permeability in limestone and other carbonate rocks is primarily a function of solution channels and jointing (a system of parallel fractures or partings in bulk rock without displacement and unrelated to bedding planes)

(Gary et al., 1972), although some carbonate rocks derive their permeability from intergranular voids (Office of Solid Waste Management Programs, 1977). Shales and highly crystalline igneous and metamorphic rocks are generally considered impermeable except where broken by joints or faults.

L.2 Contamination of Groundwater

Careless handling and improper disposal of hazardous materials has affected water quality either directly, through discharges or spills into streams or burial below the groundwater table, or indirectly, through contamination of runoff or of percolating groundwater. Even deep aquifers may be contaminated by leakage of leachates downward through improperly sealed wells or by contamination of their recharge areas. Most water quality problems associated with hazardous wastes are the result of groundwater contamination, with surface water deterioration occurring later (if at all) due to groundwater discharge of leachates.

Leaching is the process of separation, dissolution, or selective removal of soluble constituents from a material by the natural action of percolating water (Gary et al., 1972). Thus, the potential for leaching exists whenever water comes into contact with solid materials. The character of the resultant leachate varies with time and depends on the composition of the material; on environmental factors such as pH, temperature, and oxidation potential; on the exposed surface area of the material; and on the length of time the water is in contact with the material.

The various compounds identified by Dunlap et al. (1976) in groundwater from a specific landfill well are listed in Table L-1. As can be seen, most of these resulted from manufacturing processes and probably leached from potentially hazardous waste streams. The composition of leachates is extremely variable and quite site specific. Table L-2 summarizes the ranges of leachate compositions from various sanitary landfills as compiled by Chian and DeWalle (1976). Although some of the analyses may have been from sites receiving little or no hazardous wastes, they are useful for depicting the ranges of compositions which occur. Concentrations of some of the parameters vary by as much as three orders of magnitude from one site to another.

L.3 Transport and Natural Attenuation of Contaminants

The process of attenuation is, in some respects, the opposite of leaching since it involves the precipitation and filtration of various components of the leachate. However it also involves other processes such as molecular adhesion, ion exchange with clay minerals, and biological decomposition. The effectiveness of these processes is governed by some of the same variables that affect leachate generation, particularly the pH, redox potential, temperature, particle size, and permeability. In addition, the degree of attenuation is greatly dependent on the composition of the soils, particularly with respect to its clay content. Clay minerals have the capability to immobilize contaminants in groundwater through ion exchange.

TABLE L-1

COMPOUNDS IDENTIFIED IN GROUNDWATER FROM LANDFILL WELL*

Compound	Estimated concentration, µg/ℓ	Uses, sources, toxicity
Fenchone	0.2	Flavoring. Present in paper mill's raw waste.
Camphor	0.9	Plasticizer for cellulose esters and ethers, moth and mildew preventive, flavoring. Neoplastic effects produced in rats.
2,6-Di-*t*-butylbenzequinone	--	Polymerization catalyst.
Diethyl phthalate	4.1	Plasticizer, solvent for cellulose acetate, camphor substitute, perfume fixative, wetting agent. Moderately toxic when ingested.
2,6-Di-*t*-amylbenzoquinone	--	Polymerization catalyst.
Diisobutyl phthalate	0.1	Plasticizer.
Di-*n*-butyl phthalate	--	Plasticizer, polymerization catalyst, oxidant. Produces central nervous system effects.
Butycarbobutoxymethyl phthalate	--	Plasticizer.
Butylbenzyl phthalate	--	Plasticizer for polyvinyl and cellulose resins.
Dicyclohexyl phthalate	0.2	Plasticizer for rubber, polyvinyl chlorides, and other polymers.
Dioctyl phthalate†	2.4	Plasticizer for polyvinyl chlorides, and other vinyls.
p-Cresol	14.6	Constituent of creosote.
o-Xylene	0.6	Raw material for manufacture of phthalic anhydride, insecticides, motor fuels, dyes. Moderately toxic.
p-Xylene	0.9	Source of terephthalic acid for polyester resin synthesis; manufacturing of insecticides. Moderately toxic.
Cyclophexanol	1.0	Manufacture of phenolic insecticides, lacquer polishes, plastics, germicides, nylon.
N-Ethyl-*p*-toluenesulfonamide	0.1‡	Plasticizer. Moderately toxic.
N-Ethyl-*o*-toluenesulfonamide	--	Plasticizer. Moderately toxic.
C_3 Alkylbenzenes† (2 compounds)	--	American petroleum.
Diacetone alcohol	10.9	Solvent for cellulose acetate, various oils, resins, dyes, tars, and waxes. Hydraulic compression fluids, wood preservatives, and metal cleaning.
Butoxyethanol	--	Solvent for nitrocellulose resins, sprays, lacquers, and enamels.
Ethyl carbamate	--	Solvent for various organics; solubilizer and co-solvent for pesticides, fumigants, and cosmetics. Carcinogenic.

TABLE L-1 (Concluded)

Compound	Estimated concentration, μg/ℓ	Uses, sources, toxicity
Tri-n-butyl phosphate	1.7	Plasticizer, antifoam agent, solvent for nitrocellulose and cellulose acetate, heat exchange medium, dielectric. Moderately toxic by ingestion.
p-Toluenesulfonamide	--	Plasticizer, fungicide, mildewcide in paints, resin synthesis.
Methylpyridine	--	Insecticide manufacture, dyes, rubber, production of vinyl pyridine. Moderately toxic.
N,M-diethylformamide	--	Used in rubber manufacture.
Triethyl phosphate	0.3	Plasticizer for resins, plastics, gums; pesticide manufacture, catalyst, solvent, lacquer remover. Highly toxic.
bis-2-Hydroxypropyl ether	--	A dimerization product of propylene glycol, a non-toxic antifreeze used in dairies and breweries, production of synthetic resins.
3-Methylcyclopentane-1,2-diol	--	
Acetic acid	--	Production of plastics, insecticides, vinyl acetate, and photographic chemicals; oil well acidizing and food additive.
Isobutyric acid	48.7	Manufacture of esters for solvents, flavors, and perfumes; disinfection, tanning agent, deliming hides. Mild irritant. Detection of odor in water at 8.1 mg/ℓ and of taste in water at 1.6 mg/ℓ.
Butyric acid	1.5	Emulsifying agent, disinfectant, gasoline sweetner; perfume ester preparation and deliming agent. Neoplastic effects produced in rats.
Isovaleric acid	0.7	Used in flavors, perfumes, and manufacture of sedatives. Occurs in tobacco and several other plants. Detection of odor in water at 0.7 mg/ℓ.
Valeric acid	1.1	Used as an intermediate in perfumery.
2-Ethylhexanoic acid	4.2	Typical low to medium weight isoacid. Plasticizer component of alkyd resins. Salts used for varnish driers, heat stabilizers for vinyl resins, greases, thickening agents in certain lacquers and paints, sludge, and varnish inhibitor in mineral oils.
Isomeric C_6 acid†	17.1§	See 2-ethylhexanoic acid uses above.
Isomeric C_6 acid†	0.2§	See 2-ethylhexanoic acid uses above.
Isomeric C_7 acid†	7.3¶	See 2-ethylhexanoic acid uses above.
Isomeric C_8 acid†	--	See 2-ethylhexanoic acid uses above.
Cyclohexanecarboxylic acid	2.8	Insecticide formulations, stablizer for vulcanized rubber, paints and varnishes, lubricating oils, dry cleaning soaps.
Caprylic acid	0.6	Manufacture of esters used in perfumery, dye production.
Caproic acid	1.1	Manufacture of esters for artificial flavors, hexylphenols, hexylresorcinol.
Heptanoic acid	1.0	Found in fusel oils and rancid oils.

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*Dunlap et al., 1976.

†General structure confirmed beyond reasonable doubt, but position of substitution or chain branching not determined because necessary standards were unavailable or compounds were not separated by G.C. columns employed.

‡Determined as N,N-dimethyl-p-toluenesulfonamide.

§Determined as 2-ethylbutyric acid, but probably is not this compound.

¶Determined as n-heptanoic acid.

TABLE L-2

RANGE OF LEACHATE COMPOSITION IN 18 SANITARY LANDFILLS IN THE UNITED STATES*

Parameter	Concentration†
COD	40 - 89,520
BOD	81 - 33,360
TOC	256 - 28,000
pH	3.7 - 8.5
TS	0 - 59,200
TDS	584 - 44,900
TSS	10 - 700
Specific Conductance	2,810 - 16,800
Alkalinity ($CaCO_3$)	0 - 20,850
Hardness ($CaCO_3$)	0 - 22,800
Total P	0 - 130
Ortho-P	6.5 - 85
NH_4-N	0 - 1,106
NO_3+NO_2-N	0.2 - 10.29
Ca	60 - 7,200
Cl	4.7 - 2,467
Na	0 - 7,700
K	28 - 3,770
Sulfate	1 - 1,558
Mn	0.09 - 125
Mg	17 - 15,600
Fe	0 - 2,820
Zn	0 - 370
Cu	0 - 9.9
Cd	0.03 - 17
Pb	<0.10 - 2.0

*Chian and DeWalle (1976).

†All figures in milligrams per liter except Specific Conductance which is measured as micromhos per centimeter and pH as pH units.

In general aluminum, lead, copper zinc, phosphate, and trivalent chromium are the ions which are most readily adsorbed; while arsenic, selenium, chloride, nitrate, and hexavalent chromium, among others, are only weakly adsorbed (Cartwright and Lindorff, 1976). The quantity of any one species of cation adsorbed is dependent upon the type of clay minerals present in the soil, the cations already on the clay, the other cations present in solution, and the accompanying anions (Cartwright and Lundorff, 1976). Silts and sands exhibit a slight ion exchange capacity, while sand and gravel aquifers and bedrock aquifers usually provide little or no reduction of contaminant levels.

Another important factor determining the degree of attenuation achieved is the contact time of the leachate with the soil in the unsaturated zone of aeration. It follows that as the flow rate decreases, the contact time and, hence, the degree of attenuation increases (Garland and Mosher, 1975). As a concentrated leachate flows through a soil, its rate of movement is first controlled by the permeability, which, is largely dependent on the particle size of unconsolidated materials. As time passes, a phenomenon known as soil clogging occurs in all but the coarsest soils. This is generally caused by a buildup of filtered or biological decomposition products at particle surfaces (Ham, 1975).

It may be presumed that any chemical not removed or altered in the clogging zone or in the soil overlaying the water table is unlikely to be affected by similar soils within the water table (Ham, 1975). This is particularly true due to the general absence of oxygen below the water table, which precludes any further decomposition or oxidation by aerobic bacteria. Many contaminants are soluble under anaerobic conditions and will therefore remain in solution in the zone of saturation.

APPENDIX M

BACKGROUND INFORMATION ON INCINERATION OF HAZARDOUS WASTES

This appendix presents information on the destruction of hazardous wastes by incineration and on the potential for the release of air emissions from such incineration. Incineration is defined as an engineered process using flame combustion to thermally degrade materials such as hazardous wastes. Devices normally used for incineration include rotary kilns, fluidized beds, and liquid injections incinerators (see Appendix D). To the extent that incineration produces a hazardous ash or residue which requires disposal, incineration is a treatment method (e.g., volume reduction) rather than a disposal method.

As discussed below, incineration can be used to destroy or recover energy from a vast number of different hazardous waste materials, representing a broad spectrum of physical and chemical characteristics. Generally speaking, organic materials are the prime candidates for incineration. Properly designed and well maintained high temperature incinerators appear to show good potential as a means of destruction of many hazardous organic wastes; however, capital costs are quite high for such incinerators (Adams et al., 1977; Ackerman et al., 1977; Carnes and Oberacker, 1976; Leighton and Feldman, 1975; Oregon State University, 1974).

In 1977 there were only 31 hazardous waste incinerators reported to be operating in the U.S. (Straus, 1977). In addition, in 1976 there were 135 municipal incinerators in the U.S., 22 of which were operating without any air pollution control devices (Gordon et al., 1976). Some of these municipal incinerators burn various hazardous wastes, including PCB's and other industrial waste products (Moon et al., 1976; Gordon et al., 1976). This practice is being curtailed as increasing public and regulatory pressure is brought to bear to demand strict inventories of the waste streams before they are incinerated. In some cases these pressures have resulted in the shutting down of both municipal incinerators and those designed to handle hazardous wastes. Reasons for these closings include community opposition, inability to comply with state and Federal regulations, and inability to remain economically viable. Severe odor problems are often cited by opposing community groups.

The portion of any hazardous waste destroyed by incineration is dependent to a great extent on the temperature of the incineration and the dwell time (residence time in the incinerator) at that temperature and to a lesser extent on turbulence in the combustion zone and the amount of excess oxygen available. The higher the temperature used, the shorter the dwell time necessary to achieve a given destruction ratio. As a general rule, organic hazardous materials can essentially be completely destroyed at a temperature of 1000 C (1830 F) and a dwell time of 2 seconds. Many are completely destroyed at lower temperature/dwell time conditions; a few require more rigorous conditions. Information on specific incineration criteria for individual wastes is very limited (Scurlock et al., 1975). A number of large-scale studies into the criteria for incineration of hazardous wastes are currently underway (e.g., Adams et al., 1977, Midwest Research Institute, 1976, 1977; MacDonald et al., 1977). These are discussed below.

Just as the existing knowledge on incineration criteria is very limited, little information is available on the fate of hazardous waste constituents produced as a result of incineration. Most studies of emissions from the incineration of hazardous wastes have considered only the fate of the principal components of combustion, components for which regulations have been promulgated, or components for which historical data have been accumulated regarding harmful effects. Most studies have not given consideration to emissions which result from side reactions, such as the formation of polynuclear aromatics (PNA's) from the incineration of wastes containing chlorinated hydrocarbons, nor to the constituents of particulate matter entrained in stack gases (Reynolds, Smith, and Hills, 1977). Little is also known about the potential health effects from long-term, low-level exposure to many of the gaseous and particulate products of hazardous waste combustion.

Adams et al. (1977) recently completed a series of tests on the effectiveness of the thermal destruction of industrial wastes at existing commercial-scale incinerators. A total of 15 different wastes were studied using six different types of incinerators at seven separate facilities. Table M-1 summarizes the test conditions and test results. For most of the industrial wastes, destruction efficiencies exceeded 99.9 percent for waste organics and 99.99 percent for principal waste constituents. It should be noted that in the tests the incinerator operating conditions were very carefully controlled. Whether the waste destruction efficiencies obtained during the tests could be achieved under normal operating conditions is not known.

Table M-1 also shows the concentration of total organics, principal waste organic constituents, and major trace elements detected in the combustion zone; the concentration of particulates and major trace elements detected in the stack emissions; and the general characteristics of the solid residues produced during the incineration tests. Many of the solid residues contain toxic metals and other potentially hazardous constituents. It should be noted that Table M-1 shows only the major trace elements detected; other trace metals were also detected. For example, Table M-2 lists all trace metals detected on particulate filters from the test incineration of methyl methacrylate wastes.

A study by Riley (1975) reviewed and summarized available information on pesticide incineration. The study found that the overwhelming majority of available data concerned incineration of halogen containing pesticides (e.g., DDT, aldrin, and toxaphene); very little information was available about inorganic or metallo-organic pesticides (e.g., mercury compounds and arsenic compounds),

TABLE M-1

CHARACTERISTICS OF INCINERATION OF SELECTED HAZARDOUS WASTES

				Waste destruction efficiency (%)		Combustion zone effluents			Concentrations in stack emissions		
Facility type	Waste Tested	Incineration temperature (°C)	Residence time (seconds)	Total organics	Waste constituents	Total organics (mg/m^3)	Waste organics (mg/m^3)	Major trace metals (mg/m^3)	Particulates (mg/m^3)	Major trace elements (mg/m^3)	Solid residue quality
Fluidized bed	Phenol	740-757	12-14	99.93	>99.999	7.0-7.6	<6.03	1.0- 1.2 Pb	1280- 1530	0.34- 0.27 Pb	No organic waste constituents in bed sand
	Methyl methacrylate	774-788	12	99.99	>99.999	7.5	<0.16	0.85- 5.7 Pb	560-630	0.55- 2.2 Pb	No organic waste constituents in bed sand
Rotary kiln	PVC sludge	870 in primary combustion zone, 980-1090 in secondary combustion zone	2-3	99.84	>99.936	24-47	0.02- 0.04	-	71		N/A
	Hammermilled PCB containing capacitors	1252 in kiln, 1331 in afterburner	3.2	99.98	>99.999	16	<0.005	12 Pb 1.0 Sn	35	2.7 Pb	No organic waste constituents
	Whole capacitors	1139 in kiln, 1332 in afterburner	3.08	99.96	>99.999 (99.5)	23	<0.005	11 Pb 7.6 Sn	53	3.1 Pb	~500 ppm PCB's
Wet air oxidation	Coke plant effluent	279 at 109 atmospheres	1.13 hrs.	91.3 (COD)	Variable	481 mg/l COD	<53 mg/l COD	-	1	-	N/A
	Amiben®	285 at 107 atmospheres	1 hour	82 (COD)	79	2,920 mg/l COD	<100 mg/l COD	-	11		N/A
Liquid injection	Ethylene	1359-1752	0.14-0.19	99.8	>99.999	[illegible]	0.02	[illegible] Pb	[illegible]	0.003- 0.003 Pb	97-99% carbon, 0.02% organic waste constituents
	Hexachlorocyclopentadiene (C-56)	1148-1328	0.13-0.15	99.9	>99.99	11-27	<0.02	[illegible]	16-113	[illegible]	99.99% carbon, no organic waste constituents
	Nitrochlorobenzene	1302-1332	2.3	99.8	>99.999	12-53	<0.05		15-26		N/A
	API separator bottoms	760	12.5 min.	N/A	N/A	18,000- 19,000		N/A	21.85	0.35 Pb 0.05 Sn	93% inorganic; alkyl substituted aromatics and aromatic waste constituents
Pyrolysis	[illegible]	[illegible]	[illegible]	N/A	N/A	[illegible]			[illegible]		96% inorganic; organic waste constituents and some PNA's
	Rubber	760	13 min.	N/A	N/A	18,000- 29,000			0.12		89% inorganic; high molecular weight aromatic waste constituents
Cement kiln	Chlorinated aromatic [illegible]	[illegible]	[illegible]		>99.986	<0.1	<0.2	[illegible]	[illegible]		89% inorganic; no organic waste constituents
	[illegible] PCB's	[illegible]	[illegible]		>99.986	<0.1	0.1	[illegible]	[illegible]		93% inorganic; no organic waste constituents

* Adams et al., 1977.
Seconds except where noted.
▲ Concentrations not available.

TABLE M-2

TRACE METALS ON PARTICULATE FILTERS FROM TEST INCINERATION OF METHYL METHACRYLATE WASTES*

Test no.	Sampling train	Trace element concentration in gas stream (mg/m^3)						
		Ba†	Cd	Cr	Pb	Sb	V	Zn
1	Combustion zone	0.08	0.035	0.13	0.85	0.031	<0.002	0.32
	Stack	0.55	0.029	0.082	0.55	0.014	<0.005	0.12
2	Combustion zone	0.60	0.67	0.26	4.74	0.058	<0.002	0.66
	Stack	0.40	0.16	0.18	2.21	0.012	<0.004	0.072
3‡	Combustion zone	0.27	0.009	0.10	0.13	0.001	<0.002	0.24
	Stack	0.26	0.007	0.042	0.086	0.021	<0.007	0.23

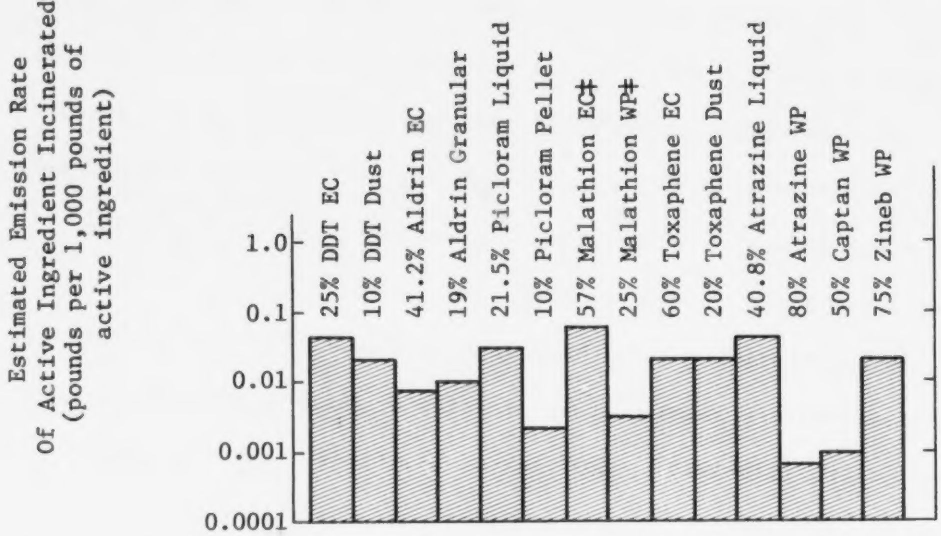
* Ackerman et al., 1977.

† Barium background levels in the filter material were very high and erratic.

‡ Background test with auxiliary number 2 fuel oil only.

phosphorus-containing pesticides (e.g., diazinon, malathion, and parathion), and nitrogen-containing pesticides (e.g., atrazine, carbaryl, and zineb). The author's analysis of the available data indicated that 99.999 percent or better destruction could be achieved for halogen-containing pesticides at temperatures of 1,090 C (2,000 F) and retention times of 0.2 seconds or temperatures of 650 to 700 C (1,200 to 1,300 F) and retention times of 8 to 10 seconds. The author indicates that nitrogen-containing pesticides produce cyanide upon combustion; destruction of this cyanide could require temperatures in excess of 950 C (1,750 F) and retention times greater than 4 seconds; lower temperatures would be required to achieve 99.999 percent or better destruction of the pesticide itself, but not of the cyanide. The author also notes that 99.999 percent or better destruction could be achieved for phosphorus-containing pesticides at temperatures between 620 and 1,040 C (1,150 and 1,900 F) and retention times between 4 and 12 seconds. The author cautions, however, that available data are not sufficient to extrapolate the findings to combustion in incinerator types other than those studied. Partial or complete combustion of the pesticides studied was found to have the potential for generation of toxic degradation products: metallo-organic pesticides could generate toxic metal oxides; phosphorus-containing pesticides could generate toxic gases such as pyrophosphates; halogen-containing pesticides could generate gases such as hydrogen chloride; and nitrogen-containing pesticides could generate cyanides.

In a later study, Carnes and Oberacker (1976) report the results of a project to ascertain the design and operational criteria for the incineration of pesticides, combustible pesticide containers, and washings from pesticide containers. Fifteen commercial formulations of pesticides were individually test-burned. The efficiency of pesticide incineration was found to be generally uniformly high over the ranges of operating variables investigated. The test data indicate that most organic pesticides can be effectively destroyed (greater than 99.99 percent of the active ingredient destroyed) over a range of combustion temperatures and retention times. However, it was determined that solid pesticide formulations may require special procedures or extended retention times to ensure complete combustion because of the potential for built-in heat resistance. As much as 10 to 30 percent of the active ingredient in 10 percent picloram pellets and 0.3 percent mirex bait were found to be present after a two second residence time at 1,000 C. The tests further showed that even when the pesticides were incinerated at 1,000 C for two seconds, emissions of the active ingredients and related species still occurred even though there was an extremely high destruction efficiency (see Figure M-1). The emission rates ranged from approximately 0.001 pounds per 1,000 pounds of active ingredient incinerated for 80 percent Atrazine WP to 0.1 pounds for 1,000 pounds of active ingredient incinerated for 57 percent Malathion EC. Other emissions that were determined to require pollution control devices include particulate matter for solid pesticide formulations, pyrophosphates (such as



*Carnes and Oberacker, 1976.

The estimated emission rate includes the respective pesticide plus all related chemical species in the incinerator off-gas.

‡Emission rate based on malathion detection limit.

FIGURE M-1

AIR EMISSIONS FROM INCINERATION OF SELECTED PESTICIDES AT 1000 C AND 2 SECONDS RETENTION*

P_2O_5) from phosphorus based pesticides, cyanide (CN^-) from nitrogen-containing organics, hydrochloric acid from chlorinated hydrocarbons, and sulfur dioxide from organosulfur compounds. Odor was also noted as a potential problem, particularly during incineration of organosulfur pesticides. The residues left from the incineration of pesticide formulations containing inert binders and carriers were found generally to contain very low levels of the pesticide being incinerated (less than 20 ppm).

While plastics are not hazardous by themselves, some potentially hazardous waste streams contain plastics or plastic polymers (Industry Studies, 1975-1978). Boettner et al. (1973) studied combustion products that result from the incineration of plastics. The study indicated that plastics composed only of carbon and hydrogen or carbon, hydrogen, and oxygen may form carbon dioxide and water when completely combusted. Incomplete combustion may result in the production of carbon monoxide as the major toxicant, plus gaseous and condensed hydrocarbon products. The condensate may have significant fuel or crude chemical value, but may contain polycyclic hydrocarbons, particularly aromatic polymers. Plastics containing nitrogen as a heteroatom may produce, on complete combustion, molecular nitrogen and small amounts of oxides of nitrogen, as well as carbon dioxide and water. On incomplete combustion hydrogen cyanide, cyanogen, nitriles, and ammonia may form in addition to hydrocarbon gases.

Any liquid condensate formed may be composed of a variety of organic nitrogen compounds as well as hydrocarbons. Nitrogen compounds from plastics containing nitrogen were found to be more sensitive than other combustion products to changes in combustion conditions. Generally, the more incomplete the combustion, the more ammonia and cyanide that formed. Plastics containing halogen or sulfur heteroatoms may form acid gases such as hydrogen chloride, hydrogen fluoride, and sulfur dioxide on complete combustion, in addition to carbon dioxide and water, and may form organic halogen or sulfur compounds on incomplete combustion.

Shapira et al. (1978) reported on air emissions from activities associated with the demilitarization of conventional munitions. Activities considered included deactivation in rotary kiln incinerators, open burning, detonation, and washout.* Table M-3 shows uncontrolled emissions from the combustion of selected munitions in a rotary kiln incinerator. Table M-4 gives emission rates from the open burning of selected energetic munitions such as propellants, pyrotechnics, and explosives. Table M-5 illustrates the emission products from both confined and unconfined detonation of selected explosives. Washout produces emissions of the organic energetic materials being demilitarized; data are not available as to the types of emissions and emission rates.

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*Washout involves the use of hot water to melt the fill in munitions such as bombs and projectives and to wash out the metal casing.

TABLE M-3

UNCONTROLLED EMISSIONS FROM COMBUSTION OF SELECTED MUNITIONS IN ROTARY KILN INCINERATOR*

Munition	Test number	Nitrogen oxides (average ppm)	Particulate concentration† (gr/scfd)	Particulate mass rate† (lb/hr)	Sulfur dioxide (average ppm)	Sulfur trioxide (average ppm)	Hydrogen chloride (ppm)
Cartridge 7.62 mm 4 ball M80 1 Tr. M62	P7	3226.	3.3763	33.90	-	-	1.0
	P8	2312.	3.4142	34.09	-	-	1.0
Cartridge Cal 30 Tracer M1	P2	7732.	8.6450	85.64	-	-	-
	P3	8178.	9.9178	92.99	-	-	-
Cartridge Cal 50 Tracer M17	P6	4732.	9.1559	82.02	-	-	0.4
	P16	4536.	6.4102	63.73	-	-	0.1
Cartridge Cal 50 API M8	P4	6799.	1.4952	15.10	-	-	0.2
	P5	8681.	1.7627	16.97	-	-	0.5
Booster M21 A4 Assembled	P14	117.	1.5580	16.92	-	-	-
	P15	75.2	.3559	3.91	-	-	-
Booster M21 A4 Disassembled	P11	538.	.3582	3.56	-	-	-
	P12	285.	.3245	3.11	-	-	-
Fuze MTSQ M 502 with Booster	P17	460.	.8544	9.34	-	-	1.0
	P18	531.	.5138	5.76	-	-	1.0
Fuze BD M66 A1	P19	163.	.9281	10.01	-	-	0.1
	P20	67.1	.6688	7.13	-	-	1.0
Primer Percussion M28 B2	P9	49.2	2.1587	21.27	39.5	282.4	0.8
	P10	40.6	2.5052	24.08	-	-	2.0
Primer Percussion M40 A2	P22	68.6	1.6865	17.67	18.8	53.2	3.0
	P23	52.9	1.7217	17.51	-	-	2.0

* Shapira, et al., 1978.

† Particulates include metals such as lead, mercury, magnesium, and aluminum.

TABLE M-4

EMISSION RATES FROM OPEN BURNING OF SELECTED ENERGETIC MATERIALS*

(pounds of gas per ton burned)

Combustion product	Black powder	HEX tritonal	Compositions B, B3, A, C, cyclotol	TNT explosive D octol	Single base propellant	Double base propellant	Composite propellant	Triple base propellant	NACO propellant	NOSOL	Tarrier sustainer propellant
Carbon monoxide	-	891.6	939.7	1,194.1	798.2	327.4	-	794.4	697.2	1,049.4	828.8
Carbon dioxide	844.0	-	337.4	189.2	757.6	1,137.0	19.0	142.6	737.2	290.2	674.2
Nitrogen	204.8	6.3	589.8	369.8	239.6	297.0	-	-	216.0	276.2	241.0
Water	-	978.2	2.3	31.0	146.6	163.4	-	480.7	138.4	333.4	140.2
Hydrogen	-	41.2	39.8	36.9	46.0	26.4	-	43.0	49.0	29.4	53.2
Carbon	18.8	12.4	-	174.8	-	-	-	-	61.4	-	44.8
Methane	-	-	1.6	4.16	10.4	14.4	-	13.8	4.52	0.1	-
Ammonia	-	-	0.03	0.03	0.03	-	-	2.72	-	0.65	-
Hydrogen sulfide	-	-	-	-	-	-	-	-	-	3.0	-
Hydrogen cyanide	-	-	2.54	-	-	-	-	2.21	-	0.88	-
Potassium hydroxide	-	-	-	-	-	-	-	-	13.2	-	-
Lead	-	-	-	-	-	-	-	-	17.8	-	17.8
Aluminum	-	21.54	-	-	-	-	-	-	-	-	-
Aluminum oxide	-	48.76	-	-	-	-	120.0	-	-	-	-
Potassium	273.8	-	-	-	-	-	-	-	-	-	-
Carbon oxisulfide	330.2	-	-	-	-	-	-	-	0.256	-	-
Sulphur	0.6	-	-	-	-	-	-	-	-	-	-
Carbon disulfide	26.3	-	-	-	-	-	-	-	-	-	-
Hydrogen chloride	-	-	-	-	-	-	340.0	-	-	-	-
Sulphur dioxide	-	-	-	-	-	-	1.0	-	-	-	-
Atmospheric constituents	-	-	-	-	-	-	1,200.0	-	-	-	-
Total gas emissions per system	1,698.5	2,000.0	1,913.2	1,999.9	1,998.4	1,965.6	1,680.0	1,479.4	1,934.9	1,983.2	1,999.0

*Shapira et al., 1978.

TABLE M-5

DETONATION PRODUCTS OF CONFINED AND UNCONFINED EXPLOSIONS*
(ppm)

	Explosive					
	PETN		HMX		TNT	
Name	Confined	Unconfined	Confined	Unconfined	Confined	Unconfined
Carbon dioxide	3.32	3.50	1.92	1.44	1.25	0.063
Carbon monoxide	1.61	1.56	1.06	2.65	1.98	5.89
Carbon	-	-	0.97	-	3.65	1.01
Nitrogen	1.95	2.00	3.68	4.01	1.32	1.36
Water	3.68	3.45	3.18	2.50	1.60	0.17
Hydrogen	0.34	0.51	0.30	1.53	0.46	2.31
Ammonia	0.056	0.0002	0.395	-	0.162	0.022
Methane	0.004	0.0002	0.039	-	0.099	0.0092
Hydrogen cyanide	-	-	0.008	0.0006	0.020	0.024
Ethane	-	-	0.001	-	0.004	-

* Shapira et al., 1978

The literature contains other reports about the incineration of hazardous wastes, primarily pesticide and PCB-containing wastes. Leighton and Feldman (1975) describe the incineration of DDT in a fluid injection, vortex combustion incinerator using waste oils contaminated with 1.7 percent PCB as fuel. Destruction efficiencies ranged from 99.9921 to 99.9995 percent for PCB and were greater than 99.9999 percent for DDT using temperatures of 871 to 982 C (1,600 1,800 F) and retention times of 1 to 12 seconds. Emission data were collected only for PCB's and DDT and its derivatives (DDD and DDE).

Reynolds, Smith, and Hills (1977) studied the energy conversion potential of industrial waste streams in eight selected industries. The study found that many of the wastes considered produce hazardous or corrosive gases when incinerated, requiring the use of pollution abatement equipment. Table M-6 shows, based upon bench scale tests, an analysis of exhaust gases from the fluidized-bed incineration of solvent recovery sludges from paint production for the specific constituents sampled. In addition, the exhaust gas scrubber effluent was examined for mercury. The observed mercury levels ranged from less than 1 ppb to almost 7 ppm. Table M-7 shows the constituents of ash from incinerated solvent recovery still bottoms at a paint production facility. The ash contains heavy metals and would require land disposal.

Gordon and Cioffi (1976) have reported on uncontrolled lead emissions from the burning of waste automotive crankcase oil as a

TABLE M-6

MASS SPECTROGRAPHIC ANALYSIS OF EXHAUST GASES FROM FLUIDIZED-BED INCINERATION OF SOLVENT RECOVERY SLUDGES FROM PAINT PRODUCTION*

Components	Run 17	Run 18	Run 21	Run 22	Run 28	Run 29	Run 33
	Concentration, percent by volume						
Carbon dioxide	10.4	12.4	10.6	8.09	7.64	11.6	12.0
Argon	1.0	1.0	0.95	0.96	0.95	0.97	1.0
Oxygen	7.41	5.47	7.13	10.06	11.6	6.96	5.75
Nitrogen	80.8	80.9	81.1	80.1	79.8	80.4	81.1
Hydrogen	0.08	0.03	0.04	0.03	0.05	0.03	0.05
Carbon monoxide	0.21	0.02	0.06	0.02	0.03	0.002	<0.001
Methane	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002
	Concentration, ppm						
Sulfur dioxide	<2	<2	ND	ND	<2	<2	ND
Hydrogen sulfide	<2	<2	ND	ND	<2	<2	ND
Carbonyl sulfide	<2	<2	ND	ND	ND	ND	ND
Ethane	37	9	ND	ND	ND	ND	ND
Hydrogen cyanide	50	39	46	103	51	12	20
Benzene	13	3	130	<2	ND	ND	ND
Nitrous oxide	28	45	21	57	63	34	185
Acetone	26	3	ND	ND	26	18	ND
Ethane	ND†	ND	ND	ND	ND	ND	ND
Ethylene	ND	ND	<2	<2	ND	ND	ND
Acetylene	ND	ND	<2	<2	ND	ND	ND

* Reynolds, Smith and Hills, 1977.

† ND - not detected.

TABLE M-7

ANALYSIS OF ASH FROM INCINERATED SOLVENT RECOVERY STILL BOTTOMS AT ONE PAINT PRODUCTION FACILITY*

Constituent†	Concentration percent
TiO_2	Major
SiO_2	15.00
SrO	2.00
Al_2O_3	0.50
Fe_2O_3	0.20
MgO	0.20
BaO	0.10
MoO_3	0.004
PbO	0.03
Sb_2O_5	0.02
CaO	0.005
NiO	0.005
SnO_2	0.005
ZnO	0.003
CoO	0.003
MnO	0.003
CuO	0.001
Cr_2O_3	0.001

*Wapora, Inc., 1975.

†Elements not detected in sample: Cd, As, Te, B, W, Ge, Bi, Be, V, Ag.

fuel. Table M-8 shows ambient air concentrations of lead near various facilities burning the waste oil as fuel.

In spite of the reported impressive performances of the incinerators in destroying waste constituents, it should be noted most of the above studies were performed under extremely controlled conditions and only specific products of combustion were sampled in many cases. Problems could occur due to the requirements for frequent maintenance and extensive operator education in order to ensure proper functioning. Maintenance is an especially serious problem since many of the wastes burned in incinerators are either extremely caustic or produce caustic products when burned. Furthermore, burning of hazardous wastes or mixtures of such wastes may release air contaminants not sampled during the studies.

TABLE M-8

AMBIENT AIR CONCENTRATIONS OF LEAD NEAR VARIOUS FACILITIES BURNING WASTE OIL AS FUEL*†

Test sponsor	Combustion site	Type of virgin fuel	Total fuel feed rate (gal./hr)	Waste oil in feed ((vol %)	Lead content of waste oil (wt %)	Stack height (ft)	Soot blowing	Maximum ground level concentration ($\mu g/m^3$)	Concentration measurement classification**
Gulf Research and Development‡	domestic oil burner	No. 2 fuel oil	3	27	1.1	15	no	4	1-hr average (C)
County of Fairfax, Virginia§	hot water boiler	No. 5 fuel oil	25	0	-	27	no	0.2	24-hr sample (M)
County of Fairfax, Virginia§	hot water boiler	No. 2 fuel oil	25	25	0.2	27	no	0.5	24-hr sample (M)
County of Fairfax, Virginia§	hot water boiler	No. 2 fuel oil	25	50	0.2	27	no	0.3	24-hr sample (M)
County of Fairfax, Virginia§	hot water boiler	None	25	100	0.2	27	no	0.1	24-hr sample (M)
Mobile Oil‡	steam boiler	No. 6 fuel oil	100	5	1.0	60	yes	1.0	30-day average (C)
Humble Oil‡	steam boiler	None	100	100	unknown	35	yes	0.05(0.65††)	short term sample(M)
Shell Oil‡	steam boiler	No. 6 fuel oil	374-476	75-100	0.5-1.0	130	yes	0.2	30-day average (C)
Hawaiian Electric Co.‡	utility boiler	No. 6 fuel oil	1,900	7	0.45	137	yes	0.11	1-hr average (C)
GCA/Technology Division¶	municipal incinerator	None	300	100	1.0	100	no	0.2	30-day average (C)

*Gordon and Cioffi, 1976.
†No control devices utilized.
‡Adapted from Chansky, Steven, James Carroll, Benjamin Kinconnon, James Sahagian, and Norman Surprenant, 1974.
§Fairfax County Public Schools, 1974.
¶Chansky, Steven, Billy McCoy, and Norman Surprenant, 1973.
**C = calculated; M = measured
††From ambient sampling during soot blowing.

APPENDIX N
PHASE I ALTERNATIVE

This appendix contains the following parts of the non-technical regulations comprising the Phase I alternative:

- Part 260 - Overview and Definitions
- Part 261 - Identification and Listing of Hazardous Waste
- Part 262 - Standards Applicable to Generators of Hazardous Waste
- Part 263 - Standards Applicable to Transporters of Hazardous Waste
- Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- Part 265 - Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- Part 266 - Standards for Owners and Operators of Facilities that Treat, Store, and/or Dispose of Wastes Identified for Discriminate Standards

PART 260 - OVERVIEW AND DEFINITIONS

Subpart A - Definitions

260.10 Definitions

Subpart B - General

[Reserved]

SUBPART A - DEFINITIONS

260.10 Definitions

(a) When used in the Regulations set forth in Parts 261, 262, 263, 264, and 265 of this title, the terms have the following meanings:

(1) "Authorized Representative" means the person responsible for the overall operation of the facility, e.g., plant manager, superintendent or person of equivalent responsibility;

(2) "Designated facility" or "permitted facility" means a hazardous waste treatment, storage or disposal facility that has received an EPA permit in accordance with regulations implementing Section 3002 of RCRA or Title I of the Marine Protection, Research and Sanctuaries Act, or that has qualified for an interim status permit under Section 3005(e) of the Act and regulations under that section, or that has a permit from a State agency authorized in accordance with Section 3006 of the Act and regulations implementing that section.

(3) "EPA identification number" means the unique number assigned by EPA to each generator, transporter, and treatment, storage, or disposal facility.

(4) "Hazardous waste discharge" means the accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying or dumping of hazardous waste onto or into the land or water.

(5) "International shipment" means the transportation of hazardous waste between a person in the United States and generator or a treatment, storage, or disposal facility owner or operator located outside the jurisdiction of the United States.

(6) "Manifest document number" means the serially increasing number assigned to the manifest by the generator for recording and reporting purposes.

(7) "Movement" means that portion of a shipment of hazardous waste which is generated by one generator, transported at any one time by the same transporter in the same vehicle and received by the same designated facility.

(8) "On-site" means the same or geographically contiguous property which may be divided by public or private right(s)-of-way. Non-contiguous property owned by the generator but connected by a right-of-way which he controls and the public does not have access to is also considered a single site.

(9) "Person" means an individual, trust, firm, joint stock company, corporation, partnership, association, State, municipality, commission, political subdivision of a State, interstate body, or Federal agency.

(10) "Shipment" means the total number of movements required to transport the entire quantity of hazardous waste intended for off-site treatment, storage, or disposal.

(11) "Transporter" means a person engaged in the transportation of hazardous waste by air, rail, highway or water.

(12) "United States" means the 50 States, District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

(13) "Waste pesticide" means unused pesticide, formulation, or prepared material, container residues, unrinsed containers, container rinsate, and application equipment wash-down liquid.

(14) "Water (bulk shipment)" means the bulk transportation of hazardous waste which are loaded or carried on board a vessel without benefit of containers or labels.

PART 261 - IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

Subpart A - General

261.1 Purpose and Scope
261.2 Definition of Solid Waste
261.3 Definition of Hazardous Waste
261.4 Exclusions

Subpart B - Criteria for Identifying and Applying Characteristics of Hazardous Waste and for Listing Hazardous Wastes

261.10 Criteria for Identifying and Applying Characteristics of Hazardous Waste
261.11 Criteria for Listing Hazardous Wastes

Subpart C - Characteristics of Hazardous Waste

261.20 Characteristic of Ignitability
261.21 Characteristic of Corrosivity
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261.23 Characteristic of Type I Toxicity
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Subpart D - Lists of Hazardous Wastes

261.30 General
261.31 Hazardous Wastes from Non-Specific Sources
261.32 Hazardous Wastes from Specific Sources
261.33 Hazardous Waste from the Discarding of Certain Commercial Chemical Products and Containers and Spill Residues Thereof
261.34 Hazardous Wastes that are Designated as Infectious Wastes
261.35-261.38 [Reserved]
261.39 Procedures for Demonstrating that a Listed Waste Generated by an Individual Facility is not a Hazardous Waste and Exempting that Waste from Regulation

Subpart E - Procedures for Petitions to Identify Characteristics of or List Hazardous Waste and Requesting and Approving Equivalent Methods

261.40 Procedures for Petitions to Identify Characteristics of or List Hazardous Waste
261.41 Procedures for Requesting and Approving Equivalent Sampling or Test Methods

Figures

Figure 1 - Compaction Tester
Figure 2 - Extractor

Appendices

Appendix I - Representative Sampling Methods
Appendix II - Extraction Test Method
Appendix III - Chemical Analysis Test Methods
Appendix IV - Radioactive Waste Test Methods
Appendix V - Infectious Waste Treatment Specifications
Appendix VI - Etiologic Agents
Appendix VII - Bases for Listing

SUBPART A - GENERAL

261.1 Purpose and Scope

This Part identifies and lists those solid wastes which are hazardous wastes and are subject to regulation under 40 CFR Parts 262 through 266 and 40 CFR Parts 122 through 124 and which are subject to the notification requirements of Section 3010 of the Act. The major provisions of this Part are:

(a) 261.2, 261.3 and 261.4 of this Subpart define those materials that are solid wastes, define those solid wastes which are hazardous wastes and list certain wastes that are excluded from regulation.

(b) Subpart B sets forth the criteria that the Administrator will use in identifying and applying characteristics of hazardous waste and in listing hazardous waste.

(c) Subpart C identifies and defines characteristics of hazardous wastes which may be used by the Administrator in listing hazardous wastes under Subpart D and must be used by generators of solid waste to identify hazardous wastes not listed in Subpart D.

(d) Subpart D lists hazardous wastes and establishes procedures for exempting, from regulation, hazardous wastes generated by individual facilities.

(e) Subpart E establishes procedures for petitioning the Administrator to identify additional characteristics of hazardous waste, and/or change the lists of hazardous waste and establishes procedures for approving equivalent sampling and test methods.

261.2 Definition of Solid Waste

(a) A solid waste is any garbage; refuse; sludge from a wastewater treatment plant, water supply treatment plant or air pollution control facility; and other material, including solid, liquid, semisolid or contained gaseous material resulting from industrial, commercial, mining or agricultural operations or from community activities which:

(1) Is not excluded as a solid waste under 261.4(a); and either

(2) Is discarded (and not used or reused) by

(i) Disposal in or on the land or water; or

(ii) Burning or incineration, by itself or with other material, where primary purpose of burning is to destroy the waste; or

(iii) Physical, chemical, biological or land treatment; or

(3) Is one of the following materials and is used or reused, or being stored for use or reuse, in or on the land or water in lieu of being discarded:

(i) waste oil, or

(ii) [Reserved]; or

(4) Is one of the following materials and is used or reused or processed for material or energy recovery, or is stored for such purposes, in lieu of being discarded:

(i) [Reserved]

(b) The Administrator will list materials in paragraphs (a)(3) and (a)(4) when he determines that:

(1) The material is or has been or, in the future, could be discarded and that its use, reuse or processing for materials or energy recovery effectively constitutes discard of the material, and

(2) The use, reuse or processing for material or energy recovery of the material, if improperly managed, may cause sufficient adverse impact to human health or the environment to warrant that the material be considered as a candidate for identification or listing as a hazardous waste.

261.3 Definition of Hazardous Waste

(a) A solid waste, as defined in 261.2, is a hazardous waste if it:

(1) Is not excluded from regulation as a hazardous waste under 261.4(b); and either

(2) Is or contains a solid waste that is listed as a hazardous waste in Subpart D which has not been exempted from regulation under the procedure prescribed in 261.39; or

(3) Is not listed as a hazardous waste in Subpart D but possesses any of the characteristics of ignitability, corrosivity, reactivity or type I toxicity as defined in Subpart C.

Comment: Under this definition a mixture or combination of solid wastes is a hazardous waste if (1) any of the wastes making up the mixture of combination is a hazardous waste listed in Subpart D or (2) the resulting mixture or combination possesses any of the characteristics identified in Subpart C.

(b) A solid waste becomes a hazardous waste when it is determined to be a hazardous waste. A determination of whether a solid waste is a hazardous waste must be made, in accordance with the requirement of 40 CFR 262.11, by or before:

(1) The waste leaves the facility at which it is generated for off-site treatment, storage or disposal; or

(2) The waste enters an on-site treatment, storage or disposal facility.

(c) A hazardous waste that enters a storage surface impoundment or a landfill facility, as defined in 40 CFR 260, will continue to be a hazardous waste for as long as it remains in the facility and will be a hazardous waste if it is removed from the facility unless it can be demonstrated that it is not a hazardous waste and is exempted as a hazardous waste under the procedures prescribed in 261.39, except that an exemption cannot take effect under 261.39(m)(2).

(d) A hazardous waste that enters a treatment or land treatment facility, as defined in 40 CFR 260, will continue to be a hazardous waste for as long as it remains in the facility. Any and all solid wastes, as defined in 261.2, that are discharged or emitted from or otherwise leave the facility, are not hazardous waste unless

(1) They are listed as a hazardous waste in Subpart D and are not exempted from regulation under 261.39; or

(2) They possess any of the characteristics of hazardous waste identified in Subpart C; or

(3) They are identified as a hazardous waste in a permit issued under 40 CFR Part 122.

261.4 Exclusions

(a) The following wastes are not solid waste for the purposes of this Part:

(1) Domestic sewage, including mixed domestic sewage and industrial wastewaters that are collected, conveyed and treated in a sewage system that serves the public, and including wastewater effluents from the treatment of sewage by such a system; and

(2) Septic tank pumpings; and

(3) Industrial wastewater discharges that are point source discharges subject to regulation under Section 402 of the Clean Water Act, as amended; and

(4) Irrigation return flows; and

(5) Point source air emissions that are subject to regulation under the Clean Air Act, as amended, 42 U.S.C. 7411 and 7412; and

(6) Source, special nuclear or by product material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq., and implementing regulations; and

(7) Dredge spoils that are disposed of in navigable waters, including wet lands, and are subject to regulation under Section 404 of the Clean Water Act, as amended.

(b) The following solid wastes are not subject to regulation as hazardous wastes under 40 CFR Parts 262 through 266 or 40 CFR Parts 122 through 124 or subject to the notification requirements of Section 3010 of the Act:

(1) Household type garbage and refuse including the residual waste from the incineration or treatment of or the recovery of energy or material resources from household type garbage and refuse; and

(2) Sewage sludge from publicly owned treatment works; and

(3) Solid wastes produced from the growing of crops or the raising of animals, including animal manures and crop residues, which are returned to the soil as fertilizers or soil conditioners; and

(4) Overburden from mining operations, unless listed as a hazardous waste in Subpart D, which is or will be reemplaced in the mine site; and

(5) In-situ mining wastes, including in-situ wastes from certain oil shale, uranium and other extraction processes which extract minerals, fuels or other materials from geological formations without removing the waste material from the formation; and

(6) Fly ash, bottom ash or boiler slag which is (i) generated by a utility or industrial boiler, process steam generator or coal gasification or liquefaction unit from the sole use of fossil fuels or from the use of certain fuels in combination with fossil fuels, including refuse-derived fuels from municipal solid waste or any alternative fuel which is not a hazardous waste and (ii) which is used in the construction of roads, as a de-icing agent on roads or as a soil conditioner; and

(7) Cement kiln dust waste used in the construction of roads or for soil conditioning, including agricultural liming; and

(8) Blast furnace slag used in the construction or maintenance of railroad beds or roads.

(c) Except for those hazardous wastes identified in subparagraphs (1) through (4) below, none of the hazardous wastes generated by a commercial establishment or the part(s) of commercial establishments that is exclusively engaged in the retailing of merchandise or an individual facility that generates and disposes of no more than 1000 kilograms (2200 pounds) of hazardous waste in any 30-day period is subject to regulation as hazardous waste under 40 CFR Parts 262 through 266 or 40 CFR Parts 122 through 124 or subject to the notification requirements under Section 3010 of the Act:

(1) Any quantity of those hazardous wastes listed under 261.33(a) or (b)

(2) Any quantity greater than 10 kilograms (22 pounds) of those hazardous wastes listed under 261.33(c)

(3) Any quantity greater than 100 kilograms (220 pounds) of those hazardous wastes listed under 261.33(d)

(4) Any quantity of a hazardous waste listed in 261.31 or 261.32, for which an exclusion limit is specified, that is generated and disposed of in an amount that exceeds the specified exclusion limit

Comment: Exclusive of the exceptions in subparagraphs (1) through (4), paragraph (c) does not specifically exclude small quantities of hazardous wastes: it only excludes hazardous wastes from retailers and generators of small quantities (less than 1000 kilograms per 30-day period) of hazardous waste. If a non-retail, individual facility generates a quantity of hazardous waste that exceeds 1,000 kilograms in any 30-day period, all quantities of hazardous wastes, including any and all quantities of individual hazardous waste(s) generated in amounts less than 1,000 kilograms per 30-day period, are subject to regulation as hazardous waste.

(d) The Administrator will revise the exclusion of paragraph (c) to reduce the 1000 kilograms for a 30-day period to 100 kilograms (220 pounds) for a 30-day period. This revision will be made through rulemaking initiated not before two years or after five years after original promulgation of this Part. The Administrator may make this reduction in steps during the three-year period.

SUBPART B - CRITERIA FOR IDENTIFYING AND APPLYING CHARACTERISTICS OF HAZARDOUS WASTE AND FOR LISTING HAZARDOUS WASTE

261.10 Criteria for Identifying and Applying Characteristics of Hazardous Waste

(a) The Administrator will identify and establish in Subpart C a characteristic of hazardous waste if, based on scientific and technical information and principles, he determines that:

(1) A solid waste that possesses the characteristic, if improperly treated, stored, transported, disposed of or otherwise managed, may:

(i) cause, or significantly contribute to an increase in, mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(ii) pose a substantial present or potential hazard to human health or the environment; and

(2) The characteristic can be defined in terms of one or more specific physical, chemical, toxic, radioactive, infectious or other property of a solid wastes or its constituent(s) that is:

(i) measurable by an available standardized test method, described or referenced in this Part, which is reasonably within the performance capability of generators of solid waste or private sector laboratories available to serve generators of solid waste; or

(ii) reasonably determinable by generators of solid waste through knowledge about their waste.

(b) The Administrator will use characteristics of hazardous waste established in Subpart C as one means of listing hazardous waste in Subpart D, in accordance with the criteria for listing hazardous wastes delineated in 261.11.

(c) Characteristics of hazardous waste established in Subpart C will be used by generators of solid wastes to determine if solid wastes, not listed in Subpart D, are hazardous wastes.

Comment: 40 CFR 262.11 prescribes the responsibilities of a generator of solid waste to determine if his waste is a hazardous waste, including his responsibility to use characteristics of hazardous waste for such determination.

261.11 Criteria for Listing Hazardous Waste

(a) The Administrator will list a solid waste as a hazardous waste in Subpart D if, after considering the criteria delineated in paragraphs (d) through (j) of this Section, he determines that the solid waste, if improperly treated, stored, transported, disposed of or otherwise managed, may:

(1) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(2) pose a substantial present or potential hazard to human health or the environment.

(b) The Administrator may list classes or types of solid waste as hazardous waste in Subpart D, if he has reason to believe that individual wastes, within the class or type of waste, typically or frequently are hazardous waste in accordance with paragraph (a).

(c) In listing a hazardous waste or class or type of hazardous waste in Subpart D, the Administrator will designate the waste as one or a combination of the following and will identify such designation by the following respective parenthetical code(s):

Ignitable Wastes	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Type I Toxic Waste	(TI)
Type II Toxic Waste	(TII)
Type III Toxic Waste	(TIII)
Radioactive Waste	(A)
Infectious Waste	(N)

(d) The Administrator will list a solid waste as a hazardous waste and will designate the waste as an ignitable waste if it possesses the characteristic of ignitability as defined in 261.20.

(e) The Administrator will list a solid waste as a hazardous waste and will designate the waste as a corrosive waste if it possesses the characteristic of corrosivity as defined in 261.21.

(f) The Administrator will list a solid waste as a hazardous waste and will designate the waste as a reactive waste if it possesses the characteristic of reactivity as defined in 261.22.

(g) The Administrator will list a solid waste as a hazardous waste and will designate the waste as a Type II toxic waste if the waste contains a toxic constituent(s), including any constituent(s) listed in Table I of 261.23, which has been shown in reputable scientific studies to have toxic effects to humans, other mammalians or aquatic life and if, after considering the following factors, he determines that the waste meets the criterion of paragraph (a):

(1) The degree and nature of the toxicity presented by the toxic constituent(s).

(2) The concentration of the toxic constituent(s) in the waste.

(3) The propensity of the toxic constituent(s) or any toxic by-product(s) or toxic degradation product(s) thereof to migrate from the waste into the environment through soluabilization, volatilization, sublimation or other transport mechanism or to be emitted into the atmosphere through burning of the waste that could attend the type(s) of improper management considered under subparagraph (7).

(4) The persistence of the toxic constituent(s) or toxic by-products or toxic degradation product(s) thereof in the environment.

(5) The potential for and rate at which the toxic constituent(s) or toxic by-product(s) or toxic degradation product(s) thereof degrades to non-toxic constituents in the environment.

(6) The potential for and degree to which the toxic constituent(s) or toxic by-product(s) or toxic degradation product(s) thereof bioaccumulates in ecosystems.

(7) The plausible and possible type(s) of improper treatment (including incineration or burning), storage, transportation, disposal and/or other management to which the waste could be subjected.

(8) The quantities of the waste generated by individual facilities and the aggregate quantities generated nationwide and/or in a particular region(s) of the country.

(9) The types, nature and severity of the human health and environmental damages that have occurred as a result of improper management of wastes containing the toxic constituent(s).

Comment: This criterion will enable the Administrator to list a solid waste as a hazardous waste if it possesses the characteristic of Type I toxicity defined in 261.23.

(h) The Administrator will list a solid waste as a hazardous waste and will designate the waste as a Type III toxicity waste if the waste contains a constituent(s) which has been shown in reputable scientific studies to be a known or suspected human carcinogen, mutagen or teratogen and if, after considering the following factors, he determines that the waste meets the criterion of paragraph (a):

(1) The degree and nature of the carcinogenicity, mutagenicity or teratogenicity presented by the constituent(s).

(2) The concentration of the constituent(s) in the waste.

(3) The propensity of the constituent(s) or any toxic by-product(s) or toxic degradation product(s) thereof to migrate from the waste into the environment through solubilization, volatilization, sublimation or other transport mechanism or to be emitted into the atmosphere through burning of the waste that could attend the type(s) of improper management considered under subparagraph (7).

(4) The persistence of the constituent(s) or any toxic by-product(s) or toxic degradation product(s) thereof.

(5) The potential for and rate at which the constituent(s) or toxic by-product(s) or toxic degradation product(s) thereof degrades to non-toxic or genetically inactive constituents in the environment.

(6) The plausible and possible type(s) of improper treatment (including incineration or burning), storage, transportation, disposal, and/or other management to which the waste could be subjected.

(7) The quantities of the waste generated by individual facilities and the aggregate quantities of the waste generated nationwide and/or in particular region(s) of the country.

(8) The types, nature and severity of the human health and environmental damages that have occurred as a result of improper management of the wastes containing the constituent(s).

(i) The Administrator will list a solid waste as a hazardous waste and will designate the waste as a radioactive waste if the waste is a solid state waste and contains radium 226 in a concentration greater than 5 picocuries per gram, and if, after considering the following factors, he determines that the waste meets the criterion of paragraph (a):

(1) The potential for and degree to which radioactive emissions generated by the radium 226 and its decay products will enter the environment under the type(s) of improper management considered under subparagraph (2).

(2) The plausible and possible type(s) of improper storage, disposal and/or other management to which the waste could be subjected.

(3) The quantities of waste that might be stored or disposed of at an individual site or in an individual area.

(4) The types, nature and severity of the human health and environmental damages that have occurred as a result of improper management of the wastes containing radium 226.

(j) The Administrator will list a solid waste as a hazardous waste and will designate the waste as an infectious waste if he determines that the waste, unless treated by one of the methods prescribed in Appendix V by and at the facility generating the waste, meets the criterion of paragraph (a) because it is generated by a source that has a high likelihood of introducing, into the waste, high concentrations of the etiologic agents listed in Appendix VI.

(k) The Administrator will use the criteria for listing presented in paragraphs (g) and (h) to establish, for any Types II or III toxic wastes listed in Subpart D, the exclusion limits referred to in 261.4(c)(4).

SUBPART C - CHARACTERISTICS OF HAZARDOUS WASTE

261.20 Characteristic of Ignitability

(a) A solid waste possesses the characteristic of ignitability if a representative sample of the waste:

(1) Is a liquid and has a flash point less than 60°C (140°F), as determined by either a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-72, or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D-3278-73, or an equivalent test method approved by the Administrator pursuant to procedures set forth in 261.41; or

(2) Is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes, and when ignited, burns so vigorously and persistently as to create a hazard during its management; or

(3) Is an ignitable compressed gas as defined in and as determined by test methods described in 49 CFR 173.300; or

(4) Is an oxidizer as defined in 49 CFR 173.151.

(b) A solid waste that possesses the characteristic of ignitability is a hazardous waste, even if not listed as a hazardous waste in Subpart D.

(c) The EPA Hazardous Waste Identification Number of a hazardous waste that possesses the characteristic of ignitability, but is not listed as a hazardous waste in Subpart D, is 1000.

261.21 Characteristic of Corrosivity

(a) A solid waste possesses the characteristic of corrosivity if a representative sample of the waste:

(1) Is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using either the test method specified in the "Methods for Chemical Analysis of Water and Wastes" (EPA-600/4-79-020, March 1979), or an equivalent test method approved by the Administrator under procedures set forth in 261.41; or

(2) Corrodes steel (SAE 1020) at a rate greater than 0.250 inch per year at a test temperature of 55°C (130°F) as determined by the test method specified in NACE (National Association of Corrosion Engineers) Standard TM-01.69 or an equivalent test method approved by the Administrator under procedures set forth in 261.41.

(b) A solid waste that possesses the characteristic of corrosivity is a hazardous waste even if not listed as a hazardous waste in Subpart D.

(c) The EPA Hazardous Waste Identification Number of a hazardous waste that possesses the characteristic of corrosivity, but is not listed as a hazardous waste in Subpart D, is 0100.

261.22 Characteristic of Reactivity

(a) A solid waste possesses the characteristic of reactivity if a representative sample of the waste:

(1) Is either (i) normally unstable and readily undergoes violent change without detonating; or (ii) reacts violently with water, or (iii) forms potentially explosive mixtures with water; or (iv) generates toxic gases, vapors or fumes when mixed with water; or (v) is a cyanide or sulfide bearing waste which can generate toxic gases, vapors or fumes in quantities sufficient to present a danger to human health or the environment when it is exposed to conditions of pH between 2 and 12.5; or

(2) Is capable of detonation or explosive reaction if subjected to a strong initiating source or if heated under confinement; or

(3) Is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or

(4) Is a forbidden explosive as defined in 49 CFR 173.51, is a Class A explosive as defined in 49 CFR 173.53, or is a Class B explosive as defined in 49 CFR 173.58.

(b) A solid waste that possesses the characteristic of reactivity is a hazardous waste even if not listed as a hazardous waste in Subpart D.

(c) The EPA Hazardous Waste Identification Number of a hazardous waste that possesses the characteristic of reactivity, but is not listed as a hazardous waste in Subpart D, is 0010.

261.23 Characteristic of Type I Toxicity

(a) A solid waste possesses the characteristic of Type I toxicity if the extract from a representative sample of the waste contains any of the contaminants listed in Table I at a concentration equal to or greater than the respective value given in the table, using the test method prescribed in paragraphs (b) and (c).

(b) The extract must be obtained by using either the Extraction Test Method described in Appendix II or an equivalent test method approved by the Administrator under 261.41.

Table I

Maximum Concentration of Contaminants for Characteristic of Type I Toxicity

EPA Hazardous Waste Identification No.	Contaminant	Maximum Concentration (milligrams per liter)
0021	Arsenic	5.0
0031	Barium	100.0
0041	Cadmium	1.0
0051	Chromium	5.0
0061	Lead	5.0
0071	Mercury	0.2
0081	Selenium	1.0
0091	Silver	5.0
0201	Endrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4 4a,5,6,7,8,8a-octahydro-1, 4-endo, endo-5,8-dimethano naphthalene	0.02
0301	Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer	0.4
0401	Methoxychlor 1,1,1-Trichloro-2,2-bis (p-methoxyphenylethane)	10.1
0501	Toxaphene ($C_{10}H_{10}CI$, Technical chlorinated camphene, 67-69 percent chlorine)	0.5
0601	2,4-D, (2,4-Dichlorophenoxyacetic (acid)	10.1
0701	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	1.0

Comment: Where the waste is in a liquid state as defined in the test method described in Appendix II, the waste itself is considered as the extract for the purposes of this Section.

(c) The concentrations of contaminants in the extract must be determined by using either the following test methods or equivalent test methods approved by the Administrator under §261.41:

(1) For arsenic, barium, cadmium, chromium, lead, mercury, selenium and/or silver: "Methods for Analysis of Water and Wastes," Environmental Monitoring and Support Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268 (EPA-600/4-79-020, March 1979).

(2) For Endrin, Lindane, Methoxychlor and/or Toxaphene: "Method for Organochlorine Pesticides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(3) For 2, 4-D and 2, 4, 5-TP Silvex: "Methods for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(d) A solid waste that possesses the characteristic of Type I toxicity is a hazardous waste even if not listed a a hazardous waste in Subpart D.

(e) The EPA Hazardous Waste Identification Numbers of a hazardous waste that possesses the characteristic of Type I toxicity, but is not listed in Subpart D, are listed in Table I.

261.24 [Reserved]
261.25 [Reserved]
261.26 [Reserved]
261.27 [Reserved]
261.28 [Reserved]

261.29 Representative Sample

For the purposes of this Subpart, a representative sample must be obtained using either one of the sampling methods described in Appendix I or an equivalent sampling method approved by the Administrator under §261.41.

SUBPART D - LISTS OF HAZARDOUS WASTES

261.30 General

(a) A solid waste, as defined in §261.2, is a hazardous waste if it is listed in this Subpart, unless it is generated by an individual facility and has been exempted from regulation under §261.39.

(b) Each of the hazardous wastes listed in this Subpart is designated by one or more of the following parenthetical code(s) in accordance with §261.11(c):

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Type I Toxic Waste	(TI)
Type II Toxic Waste	(TII)
Type III Toxic Waste	(TIII)
Radioactive Waste	(A)
Infectious Waste	(N)

(c) Each hazardous waste listed in this Part is assigned an EPA Hazardous Waste Identification Number which precedes the name of the waste. This identification number must be used in notification under Section 3010 of the Act and in certain recordkeeping and reporting requirements under 40 CFR Parts 262 through 266 and 40 CFR Parts 122 through 124.

(d) Certain of the hazardous wastes listed in this Subpart contain exclusion limits that refer to §261.(c)(4).

261.31 HAZARDOUS WASTES FROM NON-SPECIFIC SOURCES

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
3000	Spent halogenated solvents and halogenated solvent recovery sludges from degreasing operations (specific degreasing compounds will be listed)	(TII)
3500	Spent halogenated solvents and halogenated solvent recovery sludges from degreasing operations (specific degreasing compounds will be listed)	(TIII)
4900	Used engine oils	(TI, TII)
4901	Used transmission fluids	(TI, TII)
4902	Used hydraulic fluids	(TI, TII)
4903	Used general industrial lubricants	(TI, TII)
4904	Used metal working oils	(TI, TII)
4905	Paint wastes (such as latex sludge, spent solvents)	(TI, TII)
2000	Water-based paint wastes	(TI)
4300	Waste paint and varnish remover	(I, TII)
4800	Spent or waste cyanide salt solutions or sludges	(R, TII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
3001	Spent or waste complex cyanide solutions or sludges	(TII)
4550	Etching or cleaning acid (or caustic) solutions	(C, TI)
2001	Etching or cleaning acid (or caustic) sludges	(TI)
4000	Non-halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(I)
4301	Non-halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(I, TII)
4400	Non-halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(I, TIII)
3002	Halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(TII)
3501	Halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(TIII)
5100	Halogenated solvents and solvent recovery still bottoms (specific solvents will be listed)	(TII, TIII)
4101	Waste or waste off-spec toluene diisocyanate	(R)
6150	Leachate from hazardous waste disposal facilities	(TI, TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2002	Electroplating wastewater treatment sludges	(TI)
5101	Reactor clean-up wastes from the chlorination, dehydrochlorination or oxychlorination of aliphatic hydrocarbons	(TII, TIII)
5102	Fractionation bottoms from the separation of chlorinated aliphatic hydrocarbons	(TII, TIII)
5103	Distillation bottoms from the separation of chlorinated aliphatic hydrocarbons	(TII, TIII)
5104	Washer wastes from the production of chlorinated aliphatic hydrocarbons	(TII, TIII)
5105	Spent catalyst from the production of chlorinated aliphatic hydrocarbons	(TII, TIII)
5106	Reactor clean-up wastes from the chlorination of oxychlorination of cyclic aliphatic hydrocarbons	(TII, TIII)
5107	Fractionation bottoms from the separation of chlorinated cyclic aliphatic hydrocarbons	(TII, TIII)
5108	Distillation bottoms from the separation of chlorinated cyclic aliphatic hydrocarbons	(TII, TIII)
5109	Washer wastes from the production of chlorinated cyclic aliphatic hydrocarbons	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Streams	Hazard Code
5110	Spent catalyst from the production of chlorinated cyclic aliphatic hydrocarbons	(TII, TIII)
5111	Batch residues from the production of chlorinated polymers	(TII, TIII)
5112	Solution residues from the production of chlorinated polymers	(TII, TIII)
5113	Reactor clean-up wastes from the separation of chlorinated aromatic hydrocarbons	(TII, TIII)
5114	Fractionation bottoms from the separation of chlorinated aromatic hydrocarbons	(TII, TIII)
5115	Distillation bottoms from the separation of chlorinated aromatic hydrocarbons	(TII, TIII)
5116	Washer wastes from the production of chlorinated aromatic hydrocarbons	(TII, TIII)
3502	Polychlorinated Biphenyls (PCB) and PCB items as defined in 40 CFR Part 761	(TIII)

261.32 HAZARDOUS WASTES FROM SPECIFIC SOURCES

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
7000	Sub-ore and other discarded materials from uranium mining	(A)
7001	Leach zone overburden, discarded phosphate ore and slimes from phosphate surface mining	(A)
4906	Wool fabric dying and finishing wastewater treatment sludges	(TI, TII)
4907	Woven fabric dying and finishing wastewater treatment sludges	(TI, TII)
4908	Knit fabric dying and finishing wastewater treatment sludges	(TI, TII)
4909	Yarn and stock dying and finishing wastwater treatment sludges	(TI, TII)
4910	Carpet dying and finishing wastewater treatment sludges	(TI, TII)
2003	Wool scouring wastewater treatment sludges	(TI)
5117	Bottom sediment sludge from wood-treating process	(TII, TIII)
2004	Mercury bearing sludges from brine treatment and mercury bearing brine purification muds from the mercury cell process in chlorine production	(TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2005	Wastewater treatment sludge from diaphragm cell process using graphic anodes in production in chlorine	(TI)
5118	Chlorinated hydrocarbon bearing wastes from diaphragm cell process using graphite anodes in chlorine production	(TII, TIII)
2006	Wastewater treatment sludges from the production of TiO_2 pigment using chromium bearing ores by the chloride process	(TI)
2007	Wastewater treatment sludges from the production of TiO_2 pigment using chromium bearing ores by the sulfate process	(TI)
2008	Arsenic bearing sludges from purification process in the production of anitomy oxide	(TI)
2009	Antimony bearing wastewater treatment sludges from purification process in the production of antimony oxide	(TI)
2010	Wastewater treatment sludge from production of chrome green pigment	(TI)
2011	Wastewater treatment sludge from production of anhydrous & hydrated chrome oxide green pigment	(TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2012	Oven residue from the production of chrome oxide green pigments	(TI)
3003	Wastewater treatment sludge from the production of iron blue pigments	(TII)
2013	Wastewater treatment sludge from the production of chrome yellow and orange pigments	(TI)
2014	Wastewater treatment sludge from the production of molybdate orange pigments	(TI)
2015	Wastewater treatment sludge from the production of zinc yellow pigments	(TI)
7002	Slag and fluid bed prills from elemental phosphorus production	(A)
7003	Waste gypsum from phosphoric acid production	(A)
5119	Polyvinyl chloride sludge from the manufacture of polyvinyl chloride	(TII, TIII)
6151	Arsenic or organo-arsenic containing wastewater treatment sludges from production of veterinary pharmaceuticals	(TI, TII, TIII)
5700	Solvent cleaning wastes from paint production	(I, TI, TII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
4911	Water Cleaning wastes from paint production	(TI, TII)
5950	Caustic cleaning wastes from paint production	(C, TI, TII)
2016	Wastewater treatment sludges from paint production	(C, TI, TII)
2017	Air pollution control sludges from paint production	(TI)
4001	Light ends from the distillation of acetaldehyde in the production of acetic anhydride	(I)
4002	Heavy ends from the distillation of acetaldehyde in the production of acetic anhydride	(I)
3004	Distillation bottoms from the production of acetaldehyde from ethylene	(TII)
3005	Bottom stream from quench column in acrylonitrile production	(TII)
3006	Bottom stream from wastewater stripper in production of acrylonitrile	(TII)
5120	Still bottoms from final purification of acrylonitrile	(TII, TIII)
5121	Solid waste discharge from ion exchange column in production of acrylonitrile	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5122	Waste stream from purification of HCN in production of acrylonitrile	(TII, TIII)
3007	Waste stream (column bottoms) from acetronitrile purification in production of acrylonitrile	(TII)
3008	Still bottoms from aniline production	(TII)
3009	Distillation residues from separation of chlorobenzenes	(TII)
3010	Heavy ends or distillation residues from the carbon tetrachloride fractionation tower	(TII)
3011	Waste from the manufacture of dibromo-chloropropane (DBCP)	(TIIO
5123	Heavy ends (still bottoms) from fractionator in production of epichlorohydrin	(TII, TII)
5124	Heavy ends from fractionation in ethyl chloride production	(TII, TIII)
3012	Heavy ends from distillation of ethylene dichloride in ethylene dichloride production	(TII)
5125	Waste from the neutralization of spent hydrogen fluoride in the production of fluoromethanes	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5126	Spent catalyst from the fluorination reactor in the production of fluoromethanes	(TII, TIII)
5127	Still bottoms from the purification of fluoromethanes in the production of fluoromethanes	(TII, TIII)
3013	Still bottoms from production of furfural	(TII)
5128	Heavy ends from the production of glycerine from allyl chloride	(TII, TIII)
5129	Residues from the production of hexachlorophenol, trichlorophenol and 2, 4, 5-T	(TII, TIII)
2018	Lead slag from lead alkyl production	(TI)
3014	Vacuum still bottoms from the production of maleic anhydride	(TII)
3015	Still bottoms or heavy ends from methanol recovery in methyl methacrylate production	(TII)
3016	Heavy ends and light ends from the production of methyl acrylate	(TII)
3017	Heavy ends and light ends from the production of ethyl acrylate	(TII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
3018	Heavy tars from the production of phenol/acetone from cumene	(TII)
3019	Distillation residues from production of phthalic anhydride from naphthalene	(TII)
3020	Aqueous effluent from scrubbing of spent acid in nitrobenzene production	(TII)
3021	Purification column wastes from production of nitrobenzene	(TII)
5130	Still bottoms from the production of pentachloronitrobenzene	(TII, TIII)
5131	Vacuum distillation residues from purification of 1-chlor-4-nitrobenzene	(TII, TIII)
4302	Stripping still tails from production of methyl ethyl pyridines	(I, TII)
4102	Centrifuge residue from toluene diisocyanate production	(R)
5132	Spent catalyst from hydrochlorinator reactor in the production of 1,1,1-trichloroethane	(TII, TIII)
5133	Waste from the product stream stripper in the production of 1,1,1-trichloroethane	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5134	Process clean out sludges from the production of 1,1,1-trichloroethane	(TII, TIII)
3022	Column bottoms or heavy ends from the production of trichloroethylene	(TII)
3023	Heavy ends from distillation of vinyl chloride in production of vinyl chloride from ethylene dichloride	(TII)
5135	Wastewater treatment sludges from the production of aldrin	(TII, TIII)
5136	Wastewater treatment sludges from the production of alachlor	(TII, TIII)
5137	Scrubber and filter wastes from the production of atrazine	(TII, TIII)
5138	Tars from manufacture of bicycloheptadiene	(TII, TIII)
5139	Wastewater treatment sludges from the production of bromacil	(TII, TIII)
2019	Byproducts salts in production of cacodylic acid	(TI)
5140	Wastewater treatment sludges from the production of captan	(TII, TIII)
5141	Wastewater treatment sludges from the production of Carbaryl	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5142	Heavy ends and distillation residue from production of carbaryl	(TII, TIII)
5143	Wastewater treatment sludges from the production of carbofuran	(TII, TIII)
5144	Wastewater treatment sludges from the production of chlordane	(TII, TIII)
5145	Wastewater and scrub water from chlorination of cyclopentadiene in production of chlordane	(TII, TIII)
5146	Filter solids from filtration of hexachlorocyclopentadiene in production of chlordane	(TII, TIII)
5147	Wastewater treatment sludges from the production of p-chlorobenzene	(TII, TIII)
5148	Wastewater treatment sludges from the production of chloroxuron	(TII, TIII)
5149	Wastewater treatment sludges from the production of creosote	(TII, TIII)
5150	Tars from the manufacture of cyclopentadiene	(TII, TIII)
5151	Filter cake from production of diazinon	(TII, TIII)
5152	Wastewater from oxidation of aldrin solution in production of dieldrin	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5153	Wastewater from extraction of dieldrin solution in production of dieldrin	(TII, TIII)
5154	2, 6-D waste by-products from production of 2, 4-D	(TII, TIII)
5155	Wastewater treatment sludges from the production of diuron	(TII, TIII)
5156	Unrecovered triester from production of disulfoton	(TII, TIII)
5157	Still bottoms from toluene reclamation distillation in production of disulfoton	(TII, TIII)
5158	Wastewater treatment sludges from the production of disulfoton	(TII, TIII)
5159	Wastewater treatment sludges from the production of dithiocarbamates	(TII, TIII)
5160	Wastewater treatment sludges from the production of malathion	(TII, TIII)
5161	Filter cakes from filtration of dimethylphosphorothion and DMTA in production of malathion	(TII, TIII)
5162	Liquid wastes from washing and stripping in production of malathion	(TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5163	Wastewater treatment sludges from the production of methomyl	(TII, TIII)
5164	Wastewater treatment sludges from the production of methyl parathion	(TII, TIII)
2020	Byproducts salts in production of MSMA	(TI)
5165	Wastewater treatment sludges from the production of pentachlorophenol	(TII, TIII)
5166	Liquid and solid wastes from the washing, stripping and filtering of phorate in phorate production	(TII, TIII)
5167	Filter cake from the filtration of diethylphosphorodithoric acid in the production of phorate	(TII, TIII)
5168	Wastewater treatment sludges from the production of phorate	(TII, TIII)
6152	Filter cake from the filtration of toxaphene solution in production of toxaphene	(TI, TII, TIII)
6153	Wastewater treatment sludges from the production of toxaphene	(TI, TII, TIII)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
5169	Heavy ends of distillation residues from distillation of tetrachlorobenzene in production of 2, 4, 5-T	(TII, TIII)
5170	Wastewater treatment sludges from the production of trifluralin	(TII, TIII)
5171	Wastewater treatment sludges from the production of vernoloate	(TII, TIII)
6300	Wastewater treatment sludges from explosives propellants and initiating compounds manufacture	(I, C, R, TI)
2049	Wastewater treatment sludges from production of initiating compounds	(TI
7200	Wastes recovered from acid vapor scrubber stream in the production of RDX/HMX	(I, R, TII)
4051	Catch basin materials in RDX/HMX production	(C)
4103	Spent carbon columns used in treatment of wastewater LAP operations	(R)
3025	Red water and pink water from TNT production	(TII)
2021	Sludges/wastes from tub washes derived from ink formulations containing feedstocks or pigments of lead, chromium, barium, cadmium, aresenic or mercury	(TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2022	Wash water/sludges from ink printing equipment cleanup containing feedstocks or pigments of arsenic, barium, cadmium, chromium, lead or mercury	(TI)
5900	Waste ferricyanide bleach, dichromate bleach, color developer bleach fix and acid solution from photographic processing	(C, R, TI)
2023	Dissolved air flotation (DAF) float from treatment of the oily water sewer in a petroleum refinery that produces tetraethyl lead containing products or uses chromium in their cooling tower water	(TI)
2024	Slop oil emulsion solids resulting from treatment of oily water sewer in a petroleum refinery that produces tetraethyl lead containing products or uses chromium in their cooling tower water	(TI)
2025	Petroleum refining exchanger bundle cleaning solvent	(TI)
2026	API separator sludge from the API separator handling the oily wastewater sewer in a petroleum refinery that produces tetraethyl lead containing products or uses chromium in their cooling tower water	(TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2044	Chrome (blue) trimmings from leather tanning and finishing operations	(TI)
2045	Chrome shavings from leather tanning and finishing operations	(TI)
2046	Buffing dust from leather tanning and finishing operations	(TI)
2047	Sewer screenings from leather tanning and finishing	(TI)
2048	Wastewater treatment sludge from leather tanning and finishing operations except for dehairing	(TI)
4750	Wastewater treatment sludge from dehairing operations in leather tanning and finishing operations	(R, TI)
4912	Coking: Decanter tank tar/pitch/sludge	(TI, TII)
4050	Coking: Caustic neutralization waste	(C)
4913	Coking: Ammonia still lime sludge	(TI, TII)
2027	Iron Making: Electric furnace dust/sludge	(TI)
4551	Steel Finishing: Waste pickle liquor	(C, TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2028	Steel Finishing: Waste pickle liquor treatment sludge	(TI)
4801	Steel Finishing: Cyanide-bearing wastes from electrolytic coating	(R, TII)
2029	Steel Finishing: chromate and dichromate wastes from chemical treatment	(TI)
2030	Emission control dust/sludge from ferrochromesilicon (FeCrSi) production	(TI)
2031	Emission control dust/sludge from ferrochrome (FeCr) production	(TI)
2032	Emission control dust/sludge from ferromanganese (FeMn) production	(TI)
2050	Lead-bearing wastewater treatment sludges from gray iron foundries	(TI)
2033	Emission control dust/sludge from smelter furnace converters	(TI)
2034	Wastewater and/or acid plant blowdown treatment sludge/lagoon solids	(TI)
2051	Primary lead: lagoon dredging from smelter	(TI)

EPA Hazardous Waste Identification Number	Waste Stream	Hazard Code
2035	Process wastewater and/or acid plant blowdown	(TI)
2036	Electrolytic anode slimes/sludges	(TI)
2037	Cadmium plant leachate residue (iron oxide)	(TI)
3024	Spent potliners (cathodes) from primary aluminum reduction	(TII)
7004	Chlorinator residue and clarifier sludge from zirconium extraction	(A)
2038	Emission control dust/sludge from secondary lead smelting	(TI)
2039	Wastewater treatment sludges from lead acid storage battery production	(TI)
2040	Cleanup wastes from cathode and anode paste production from lead acid battery production	(TI)
2041	Wastewater treatment sludges from nickel-cadmium battery production	(TI)
2042	Wastewater treatment sludges from cadmium-silver oxide battery production	(TI)
2043	Wastewater treatment sludges from magnesium carbon battery production	(TI)

261.33 Hazardous Wastes from the Discarding of Certain Commercial Chemical Products and the Containers and Spill Residues Thereof

(a) Any commercial chemical product or manufacturing chemical intermediate that is typically known by a name listed in paragraph (e) and which is to be discarded in a manner defined in §261.2(a)(2).

(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would typically be known by a name listed in paragraph (e) and which is to be discarded in a manner defined in §261.2(a)(2).

(c) Any container or inner liner of a container that has been used to transport, store or otherwise hold any commercial chemical product or manufacturing chemical intermediate that is typically known by a name listed in paragraph (e), and which is to be discarded in a manner defined in §261.2 (a)(2), unless the container has been triple rinsed using a solvent capable of removing the commercial chemical product or manufacturing chemical intermediate or has been cleaned by another method that has been shown in the scientific literature or by tests conducted by the generator, to achieve equivalent removal, or unless, in the case of a container, the inner liner that prevented contact of the commercial chemical product or manufacturing chemical intermediate where the container has been removed.

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill in or on the land or water of any commercial chemical product or manufacturing chemical intermediate that is typically known by a name listed in paragraph (e).

Comment: The phrase "commercial chemical product or manufacturing chemical intermediate that is typically known by the name listed in paragraph (e)" refers to a chemical substance which is manufactured or formulated for commercial or manufacturing use. It does not refer to a material, such as a manufacturing process waste, that contains any of the substances listed in paragraph (e). Where a manufacturing process waste is deemed to be a hazardous waste because it contains a substance(s) listed in paragraph (e), such waste will be listed either in §261.31 or §261.32 or will be identified as a hazardous waste by the characteristics in Subpart C. Additionally, the effect of paragraphs (a), (b) and (c) of this Section is not to list chemical substances or containers thereof that are destined for continued commercial or manufacturing use or for commercial or manufacturing reuse or processing for material or energy recovery. A chemical substance or container thereof listed in accordance with paragraphs (a), (b) and (c) is a hazardous waste only if it is discarded in a manner defined in §261.2(a)(2).

(e) The commercial chemical products or manufacturing chemical intermediates referred to in paragraphs (a) through (d), and the corresponding EPA Hazardous Waste Identification Numbers are listed in Table 2.

261.34 Hazardous Wastes that are Designated as Infectious Wastes

(a) Hospital wastes (N). Any of the following wastes from a hospital in SIC Codes 8062 and 8069 which contain any of the designated etiologic agents in Appendix VI, unless the waste is treated by and at the hospital by one of the treatment methods prescribed in Appendix V.

(1) All waste from areas of the hospital housing or treating patients held in "strict" or "wound and skin" isolation and all feces from patients with diseases of unknown cause.

(2) All waste from the microbiological laboratories of the hospital.

(3) All waste from laboratories of the hospital handling blood or blood products.

(4) All pathological wastes from the hospital that derive from emergency treatment or surgery of patients having infectious diseases or diseases of unknown cause.

(5) All sharp objects, including needles, syringes, and blades, used in the treatment of patients with infectious diseases or diseases of unknown cause or used in administering disease vaccines.

(b) Veterinary hospital wastes (N). Any of the following wastes from a veterinary hospital in SIC Codes 9741 and 0742 which contain any of the etiologic agents in Appendix VI, unless the waste is treated by and at the hospital by one of the treatment methods prescribed in Appendix V:

Table 2

Reactive Materials (R)

EPA Hazardous Waste Numbers	Substance
8001	Ammonium picrate
8002	Dichlorosilane
8003	Diethylarsine
8004	Mercury fulminate
8005	Nitroglycerine
8006	Phosphine
8007	Stannic chloride

(2) Toxic Materials

Substance

Acetato, phenyl-mercury

Acetic acid, idio-sodium salt

Acetic acid, thallium (I) salt

3-(alpha-Acetonylbenzyl)- 4-hydroxy courmarin

3-(alpha-Acetonylbenzyl)- 4-hydroxy courmarin, sodium salt

1-Acetyl-2-thio-urea

Acetylenedicarboxylic acid, monpotoassium salt

Acrolein

Allyl alcohol

Allylacetate

5-(Aminomethyl)-3-isoxozolol

6-Amino-1,1a,2,8,8a,8b-
hexahydro-8-(hydroxy methyl)-
3a-methoxy-5-methyl-, carbamate,
azirino (2',3':3,4) pyrrolo
(1,2a) indole-4,7-dione (ester)

4-Aminopyridine

2-(aminocarbonyl) oxyl)-N,N,N-
trimethyl-,chloride enthananinium

Arsenic acid

Arsenic acid, calcium salt

Arsenic Pentoxide

Arsenious acid, monosodium salt

Arsenic trioxide

Benzenearsenic acid

Benzenesulfonyl chloride

Benzenethiol

bis (chloromethyl) ether

Bromo-acetic acid

Brucince

2-Butanone peroxide

2-sec-Butyl-4,6-dinitro-phenol

Calcium cyanide

Carbamic acid, methylester
with N'-(m-hydro-)

2-2-dichlorovinyl dimethyl
phosphoric acid ester

1,2:3,4-Diepoxy butane

2-diethoxylphinylimino-4-methyl-
1-1,3-ditholane

2-Diethyl O-pryazinyl
phosphorothioate, O

Diethylamino-acetonitrile

Dihydrochloride emetine

3,4-Dihydroxy-alpha-(methylamino),
(-)-benzyl alcohol

Dimethyl disulfide

3,3-dimethyl-1-methylthio-O-
(methylamino carbonyl)-

2-butanone oxime

alpha-Dimethylbenzylhydro-peroxide
alpha

alpha-Dimethylphenethylamine, alpha

4,6-Dinitro-o-cresol

4,6-Dinitro-o-cresol, sodium salt

2,4-Dinitrophenol

xyphenyl-N,N-dimethyl-
formamidine, hydrochloride

Carbonachloride acid, methyl
ester

Carbonyl fluoride

2-Chloro, methyl, acyrlic acid
ester

1-(p-Chlorobenzoyl)-5-methoxy-2-methyl-indole-3-acetic acid

1-(o-Chlorophenyl)-thio-urea

3-Chloropropionitrile

alpha-chlorotoluene

2-Chloropyridine

Cyanogen

2-Cyclohexen-1-one

Cytisine

Diacetoxydibutylstannane

1,2-Dibromo-3-chloro propane

Dibutylozostannane

1,4-Dichloro-2-butane

1,2-dichloro-ethane

2,4-Dithiobiuret Ethenetetracarbonitrile

Ethoxypropyl acrylic acid, ester

3-Ethyl-2-(5- (3-ethyl- 2-benzothiazolinylidene) -1, 3-pentadienyl)-benzothiazolium, iodide

3-ethyl-3-methyl-glutarimide

N,N'-Ethylenebis (3-flroro-salicylideneiminato)- Cobaltz (EI)

Ethylenimine

2-Fluoro-acetamide

5-Fluoro-uracil

Furfuryl alcohol

1,2,3,4,10,19-Hexachloro-1,4,4a,5,8,8a-Hexahydroendo, endo-1,4:5, 8-dimethanonaphthalene

Hexachloro propane

1,1,1,3,3,3-Hexafluoro-2-propane

Hydrocyanic acid

Hydrogen sulfide

Hydroxyacetonitrile

Iodoacetic acid

1H-Indole-3-butanoic acid

Isocyanic acid, methyl ester

p-Mentha-6,8-dien-2-one, (s)-(+)-

Mercury (II) chloride

Mercury (II) cyanide

Mercury (II) iodide

Mercury (II) oxide

Methanerthiol

Methyl hydrazine

2-Methyl-2-(methylthio-,) O-(methylcarbamoyl) propionaldehyde oxime

alpha-Methylphenethylamine (+)-

2-methyl-3-(3,7,11,15- tetramethyl-2-hexecenyl)-1,4 naphthalendeione

2-methylaziridien

2-methyllactronitrile

1-(napthyl)-2-thio-urea

B-Napthylamine

Nickel carbonyl

2-Nitro propane

p-Nitroaniline

Nitrogen dioxide

1-nitrophenyl-3-(3-pyridylmethyl) urea

N-Nitrosodimethylamine

Octamethylpyrophosphoramide

Oleyl alcohol condensed
with 2 moles ethylene oxide

Osmium tetroxide

7-Oxabicyclo (2.2.1) haptane-2,3-dicarboxylic acid

Pentachlorophenol

Pentachlorophosphorane

1-Phenal-2-thio-urea

Phenyl acetonitrile

1,4-Phenylenedi-isothiocyanic acid

N-Phenylmaleimide

Phosphorofluoridate, bis (1-methylethyl)

Phosphorothioic acid, 0,0-dimethyl ester, 0-ester with p-hydroxy-

Phthalonitrile

Potassium fluorozirconate

Potassium silver cyanide

Propionitrile

1,2-Propanediol

2-Propyn-1-ol

9,10-Secocholesta-5,7,10(19)-trien-3-beta-ol

Selenious acid, disodium salt

Seleno-urea

Silver (I) Nitrate

Sodium azide

Strychnine

Tetraethyl plumbane

Tetranitromethane

Thallic oxide

Thallium (I) carbonate

Thallium (I) chloride

Octadecanoic acid cadmium salt

Thallium (I) nitrate

Thallium (I) sulfate

Thiosemicarbazide

Sulfonimide

Vanadic acid, ammonium salt

Vanadium pentoxide (dust)

Vinyl chloride

Zinc phosphide

(1) Tissues, organs, limbs from surgery of diseased animals.

(2) Carcasses of diseased animals.

(c) Medical and research laboratories (N). Any of the following wastes from medical and research laboratories in SIC Codes 7391, 8071 and 8922 which contain any of the designated etiologic agents in Appendix VI, unless the waste is treated by and at the laboratory by one of the treatment methods prescribed in Appendix V:

(1) Laboratory animals and associated materials used in the research of infectious diseases caused by the etiologic agents listed in Appendix VI.

(2) Contaminated glassware (including pipettes, petri dishes, specimen slides, tissue culture bottles, capillary tubes and flasks), body tissues, organs, bones, disposable rubber gloves, laboratory coats and swabs used in the research of infectious diseases caused by the etiologic agents listed in Appendix VI.

261.35 [Reserved]
261.36 [Reserved]
261.37 [Reserved]
261.38 [Reserved]

261.39 Procedures for Demonstrating that a Listed Waste Generated by an Individual Facility is not a Hazardous Waste and Exempting that Waste from Regulation

(a) A solid waste that is generated by an individual facility, and which is listed as a hazardous waste in §§261.31, 261.32 or 261.34 of this Subpart, will be exempted from regulation under 40 CFR Parts 262 through 266 and 40 CFR Parts 122 through 124, if (1) the generator of the waste or any other person involved in the management of the waste submits a demonstration in accordance with paragraphs (b) through (k) of this Section, and (2) if an exemption is granted by the Administrator or becomes effective under paragraph (m)(2) of this Section. The Administrator must grant an exemption if the generator or other person demonstrates, in accordance with paragraphs (b) through (h), as appropriate, that the waste does not meet the criterion (or criteria) under which the waste was listed.

Comment: An exemption under this Section will not apply to the notification requirements under Section 3010 of the Act, nor to requirements under Subtitle D of the Act.

(b) If the waste is designated as an ignitable waste in this Subpart, it must be demonstrated that representative samples of the waste do not possess the characteristic of ignitability as defined in §261.20 using either the test methods prescribed in §261.20, where applicable, or equivalent test methods approved by the Administrator under §261.41.

(c) If the waste is designated as a corrosive waste in this Subpart, it must be demonstrated that representative samples of the waste do not possess the characteristic of corrosivity as defined in §261.21 using either the test methods prescribed in §261.21 or equivalent test methods approved by the Administrator under §261.41.

(d) If the waste is designated as a reactive waste in this Subpart, it must be demonstrated that representative samples of the waste do not possess the characteristic of reactivity as defined in §261.22.

(e) If the waste is designated as a Type II toxic waste in this Subpart, it must be demonstrated that:

(1) Representative samples of the waste do not contain the toxic constituent(s) that caused the Administrator to list the waste using the appropriate test methods prescribed in Appendix II and Appendix III or equivalent test methods approved by the Administrator under §261.41; or

(2) Representative samples of the wastes do not meet the criterion of §261.11(a) after considering all of the factors delineated in §261.11(g).

(f) If the waste is designated as a Type III toxic waste in this Subpart, it must be demonstrated that:

(1) Representative samples of the waste do not contain the carcinogenic, mutagenic or teratogenic constituent(s) that caused the Administrator to list the waste using either the test methods prescribed in Appendix III or equivalent test methods approved by the Administrator under §261.41; or

(2) Representative samples of the waste do not meet the criterion of §261.11(a) after considering all of the factors delineated in §261.11(h).

(g) If a waste is designated as a radioactive waste in this Subpart, it must be demonstrated that:

(1) Representative samples of the waste do not contain radium 226 in a concentration greater than 5 picocuries per gram, if the waste is a solid-state waste, using either the test methods prescribed in Appendix IV or equivalent test methods approved by the Administrator under §261.41; or

(2) Representative samples of the waste do not meet the criterion of §261.11(a) after considering all of the factors delineated in §261.11(i).

(h) If a waste is designated as an infectious waste in this Subpart, it must be demonstrated that the waste does not meet the criterion of §261.11(a) by virtue of having a high likelihood of introducing into the waste high concentraions of the etiologic agents listed in Appendix VI.

(i) For the purposes of paragraphs (e) and (f), the constituents that caused the Administrator to list the waste are identified in Appendix VII.

(j) For the purposes of this Section, representative samples:

(1) must consist of enough samples, but in no case less than four samples, taken at different times and at different points in the waste to adequately represent the variability or, alternatively, the uniformity of the waste; and

(2) must be obtained using either the sampling methods prescribed in Appendix I or equivalent sampling methods approved by the Administrator under §261.41.

(k) A demonstration must be submitted to the Administrator by certified mail and must include the following information except for infectious waste, where the demonstration must include the information delineated in subparagraph (6):

(1) General information.

(i) The name, address and identification number of the person submitting the demonstration; and

(ii) The name and address of the laboratory facility performing the sampling and/or tests of the waste if different from that of the person submitting the demonstration; and

(iii) The name(s) and qualification(s) of the person(s) sampling the waste; and

(iv) The name(s) and qualifications(s) of the person(s) testing the waste; and

(v) The dates of the sampling of the waste; and

(vi) The date(s) of the testing of the waste.

(2) Waste and waste source information.

(i) The address or location of the individual facility producing the waste covered by the demonstration; and

(ii) A description of the manufacturing process(s) or other operation(s) and feed material(s) producing the waste and an assessment of whether such process(s), operations(s) or feed material(s) can or might produce a waste(s) that is not covered by the demonstration; and

(iii) A description of the waste and an estimate of the average and maximum monthly and annual quantities of waste covered by the demonstration; and

(iv) Pertinent data on and discussion of the factors delineated in the respective criterion for listing a hazardous waste, where the demonstration is based on subparagraphs (e)(2), (f)(2) or (g)(2).

(3) Waste sampling information.

(i) A description of the methodology(s) and equipment used to obtain the representative samples; and

(ii) A description of the sample handling and preparation techniques, including techniques used for extraction, containerization and preservation of the samples.

(4) Waste testing information.

(i) A description of the test(s) performed; and

(ii) The results of each test performed; and

(iii) The names and model number of the instruments used in performing the tests.

(5) Certification/signature. The following statement signed by the person submitting the demonstration:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(6) For infectious waste.

(i) The information specified in subparagraphs (1)(i), (2)(i), (2)(iii) and (5); and

(ii) Pertinent data substantiating the demonstration of paragraph (h).

(1) A demonstration will not be considered as received by the Administrator until all of the information prescribed in paragraph (k) is submitted. Within 90 days of receiving an incomplete submission, the Administrator must inform, in writing, the person submitting the demonstration of the missing information.

(m) An exemption will become effective:

(1) When and to the extent that the Administrator grants the exemption; or

(2) On a date 90 days after the Administrator receives a complete demonstration in accordance with paragraph (1) unless he grants or denies an exemption on or before such date.

(n) An exemption will only apply to the solid waste from the individual facility covered by the demonstration and will not apply to listed hazardous waste from any other facility.

(o) The Administrator may exempt only part of the solid waste for which the demonstration is submitted, where he has reason to believe that variability of the waste justifies a partial exemption.

(p) The Administrator must publish, in the Federal Register, a notice of each exemption that he has granted or which has been allowed to become effective under paragraph (m)(2).

(q) The Administrator will deny an exemption if he determines that:

(1) Complete information has not been submitted under paragraph (k); or

(2) The representative samples used in the demonstration fail to adequately represent the waste covered by the demonstration; or

(3) Adequate sampling and/or test methods and procedures were not used; or

(4) The demonstration fails to meet the requirements of paragraphs (b) through (h), as appropriate; or

(5) The demonstration is flawed by fraudulent or inaccurate information.

(r) The Adminsistrator will revoke an exemption which has been granted or allowed to become effective under paragraph (m)(2) if he determines that:

(1) Any of the causes delineated in paragraph (q) apply; or

(2) A revision of Subpart D causes the exempted waste to be listed against additional or revised criteria.

(s) If the Administrator denies or revokes an exemption, he must inform the person who submitted the demonstration in writing of the denial or revocation and state the reasons for the denial or revocation.

(t) Where the Administrator denies or revokes an exemption, the person who submitted the demonstration may request a public hearing. Where the Administrator grants an exemption or an exemption is allowed to become effective in accordance with subparagraph (m)(2), an interested party, who can show that he is aggrieved by such an action, may request a public hearing. The Administrator may grant a request for a public hearing if he has reason to believe that genuine and relevant factual information will be presented in the hearing. Each hearing must be preceded by adequate public notice, will be an informal rather than a formal hearing and will presided over by a person named by the Administrator.

(u) The decision(s) of the presiding officer at the hearing held under paragraph (s) will constitute final Agency action, and cannot be appealed to the Administrator.

(v) While a request for a hearing is pending, the action being appealed will be considered effective, except that, at his discretion, the Administrator may grant a request for a stay of the effectiveness, pending the outcome of the hearing.

SUBPART E - PROCEDURES FOR IDENTIFYING ADDITIONAL CHARACTERISTICS OF OR LIST/DELIST HAZARDOUS WASTE AND REQUESTING AND APPROVING EQUIVALENT METHODS.

261.40 Procedures for Petitions to Identify Additional Characteristics of or List/Delist a Hazardous Waste

(a) Any person, including any State Governor, may petition the Administrator to identify and establish a characteristic of a hazardous waste or to list or delist a hazardous waste by following the procedures established in this Section.

(b) The petition must be submitted to the Administrator by certified mail and must include the following general information:

(1) The name, address and identification number of the petitioner; and

(2) The principal contact, title and telephone number if different from above.

(c) Any petition to identify and establish a characteristic of a hazardous waste must include the following information, in addition to that prescribed in paragraph (b);

(1) A detailed description of the specific physical, chemical, toxic, radioactive, infectious or other property(s) of a solid waste that cause it to be a hazardous waste pursuant to the criteria delineated in §261.10 (a)(1) and that the Administrator can use to establish the characteristic pursuant to §261.10 (a)(2); and

(2) The concentration or level of each property that causes the waste to be hazardous; and

(3) A detailed justification for selection of the property(s) and the concentration(s) or level(s) identified pursuant to paragraphs (1) and (2), including references to studies, descriptions of incidents in which waste exhibiting the characteristic caused damage to human health or the environment and any other factors or reasons known to the petitioner which may be relevant to the identification of a characteristic of a hazardous waste; and

(4) A detailed description of, or published reference(s) to, the standardized testing protocol(s) available for measuring the property(s) and concentration(s) of level(s) identified pursuant to subparagraphs (1) and (2). Additionally, the petitioner must include an estimate of the available testing capability and capacity in the United States to perform such standardized testing protocols.

(d) Any petition to list a solid waste as a hazardous waste must include the following information, in addition to that prescribed in paragraph (b):

(1) A description of the waste and an identification of the manufacturing process(s) or source(s) from which the waste is generated; and

(2) Identification of the constituent(s), respective concentration(s) or level(s) of the constituent(s) and hazard code that cause the waste to be a hazardous waste pursuant to the criteria delineated in §261.10 (a)(1); and

(3) Such other information as the petitioner has or can reasonably be expected to have in his possession that supports the listing of the waste, including those factors identified in §261.11(h) or (i).

(e) Any petition to delist a solid waste as a hazardous waste which is listed in §261.31, §261.32 or §261.33 must include the following information, in addition to that prescribed in paragraph (b):

(1) Waste and waste source information.

(i) The name, address and identification number of the facility(s) producing the waste covered by the demonstration; and

(ii) A description of the manufacturing process(s) or other operation producing the waste and an assessment of whether such process(s) or operation can or will produce a waste that is not covered by the demonstration; and

(iii) A description of the waste(s) and an estimate of the maximum monthly and annual quantities of the waste covered by the demonstration.

(2) Waste sampling information.

(i) The name, address and identification number of the facility(s) producing the waste from which samples were collected; and

(ii) A diagram illustrating the various points from which samples were collected at the facility(s) sampled; and

(iii) A description of the methodology(s) used to obtain the representative samples; and

(iv) A description of the equipment used in collecting and handling the samples; and

(v) A description of the sample handling techniques, including techniques used for extraction, containerization and preservation of the samples; and

(vi) The name(s) and qualification(s) of the person(s) sampling the waste; and

(vii) The date(s) of the sampling of the waste.

(3) Waste testing information.

(i) A description of the test(s) performed; and

(ii) The results of each test perfomed; and

(iii) The names and model numbers of the instruments used in performing the tests; and

(iv) The name and address of the laboratory facility(s) performing the testing; and

(v) The name(s) and qualification(s) of the person(s) testing the waste; and

(vi) The date(s) of the testing of the waste.

(f) Any petition submitted to the Administrator to identify and establish a characteristic of a hazardous waste, to list a hazardous waste, or delist a hazardous waste which is listed in §261.31, §261.32 or §261.33 must include the following statement signed by the person submitting the demonstration:

> I certify under penalty of law that I have personally examined and am familiar with the demonstration and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(g) A demonstration will not be considered as received by the Administrator until all the information prescribed in paragraphs (b) and (f) and (c) or (d) or (e) and such other information as the Administrator may reasonably require and request is submitted. Within 90 days of receiving an incomplete submission, the Administrator must inform, in writing, the person submitting the demonstration of the missing information.

(h) The Administrator must act on a petition within 90 days after receipt of a completed petition. Action on a petition shall be any one of the following:

(1) Publication in the Federal Register of a Proposed Rule to establish a characteristic(s) of a hazardous waste or list a hazardous waste(s) as requested, in whole or in part, or delist a solid waste as a hazardous waste which is listed in §261.31, §261.32, §261.33, in whole or in part, in the petition; or

(2) Publication in the Federal Register of an Advanced Notice of Proposed Rulemaking (ANPR) to establish a characteristic(s) of a hazardous waste or list a hazardous waste(s) as requested, in whole or in part, or delist a solid waste as a hazardous waste which is listed in §261.31, §261.32, or §261.33, in whole or in part, in the petition; or

Comment: An ANPR will normally be used for those petitions to identify a new characteristic or for those petitions to list a waste, where the submitted information merely identifies the waste stream and the constituent(s) of concern.

(3) Publication of a Notice in the Federal Register announcing that the petition has been denied and giving the reasons for such denial. The Administrator may reject the petition for good cause, including:

(i) The submission of insufficient information, against the requirements in this Section; or

(ii) The failure of test results, as required by this Section, to demonstrate that the solid waste is not a hazardous waste; or

(iii) The failure of the demonstration to represent the waste(s) for which the petition is sought; or

(iv) The submission of fraudulent information or test results or the submission of test results derived from inadequate test procedures.

(i) The Administrator's action under paragraph (H) must be based on criteria prescribed in §261.10 or §261.11.

(j) The Administrator may not promulgate a characteristic of a hazardous waste or a listing of a hazardous waste or delist a solid waste as a hazardous waste which is listed in §261.31, §261.32, or §261.33 without following the procedures of the Administrative Procedures Act.

(k) Where the Administrator rejects or revokes a petition pursuant to paragraph (h)(3), the person who submitted the petition may request that a public hearing be held. The Administrator may grant the request for a public hearing if he has reason to believe that genuine relevant factual information will be presented at such a hearing. Each hearing must be preceeded by adequate public notice, shall be an informal rather than a formal hearing and will be presided over by a person named by the Administrator.

(l) The presiding officer will decide whether the Administrator's denial of the petition will stand or whether the Administrator must publish, in the Federal Register, a Proposed Rule or an Advanced Notice of Proposed Rulemaking covering all or part of the petition. The decision(s) of the presiding officer at the hearing held under paragraph (k) will constitute final Agency action and cannot be appealed to the Administrator.

(m) While a request for a hearing is pending, the decision which is being appealed will be considered effective, except that, at his discretion, the Administrator may grant a request for a stay of the effectiveness, pending the outcome of the hearing.

261.41 Procedures for Requesting and Approving Equivalent Methods

(a) Any person who desires to use a testing or analytical method other than a method prescribed in this Part must demonstrate, to the satisfaction of the Administrator, that such method is equal or superior to the method(s) prescribed in this Part in terms of its detectability, accuracy, reproducibility, precision and detectable limits.

(b) A petition for the Administrator's approval of an equivalent method must include:

  (1) The name, address and identification number, if applicable, of the petitioner;

  (2) A full description of the equivalent method, including a description of any equipment used;

(3) Results obtained from use of the equivalent method which demonstrate and define the detectability, accuracy, precision, reproducibility and minimum detection capability of the method;

(4) Comparative results obtained from use of the equivalent method and the method prescribed in this Part which demonstrate the equivalency of the methods in terms of detectability, accuracy, precision, reproducibility and minimum detection capability; and

(5) An assessment of any factors which interfere with the capacity of the equivalent method to produce representative results within its range of detection, reproducibility and precision; and

(6) A statement that the testing or analytical method tested is representative of the candidate method in the petition.

(7) For candidate automated methods, the petition must also contain the following:

(i) A detailed description of the quality control program that will be utilized, if the candidate method is designated as an equivalent method, to ensure that all analyzers offered for sale under that designation will have essentially the same performance characteristics as the analyzer tested in accordance with this part.

(c) After receiving a petition for an equivalent method determination, the Administrator will publish notice of the petition in the Federal Register and, within 180 calendar days after receipt of the petition, take one or more of the following actions:

(1) Send notice to the petitioner in accordance with paragraph (h) that the candidate method has been determined to be an equivalent method;

(2) Send notice to the petitioner that his petition has been rejected, including a statement of reasons for rejection;

(3) Send notice to the petitioner that additional information must be submitted before a determination can be made and specify the additional information

that is needed (in such cases, the 180-day period shall commence upon receipt of the additional information);

(4) Send notice to the applicant that additional tests are necessary and specify what tests are necessary and how they shall be interpreted (in such cases, the 180-day period shall commence upon receipt of the additional test data); or

(5) Send notice to the applicant that additional tests will be conducted by the Administrator, specifying the nature and the estimated time required (in such cases, the 180-day period shall commence 1 calendar day after the additional tests have been completed).

(d) Submission of a petition for an equivalent method determination shall constitute consent for the Administrator or his authorized representative, upon presentation of appropriate credentials, to witness or observe any tests required by this Part in connection with the petition or in connection with any modification by the petitioner.

(e) The applicant shall have the right to witness or observe any test conducted by the Administrator in connection with the petition or in connection with any modification or intended modification of the method by the petitioner.

(f) Any tests by either party that are to be witnessed or observed by the other party shall be conducted at a time and place mutually agreeable to both parties.

(g) A candidate method determined by the Administrator to satisfy the applicable requirements of this Part shall be designated as equivalent method (as applicable), and a notice of the designation must be submitted for publication in the Federal Register not later than 30 days after the determination is made.

(h) A notice indicating that the method has been determined to be a reference method or an equivalent method must be sent to the petitioner. This notice shall constitute proof of the determination until a notice of designation is published in accordance with paragraph (g) of this section.

(i) The Administrator will maintain a current list of methods designated as equivalent methods in accordance with this

Part and will send a copy of the list to any person or group upon request. A copy of the list will be available for inspection or copying at EPA Regional Offices.

(j) Where the Administrator rejects or revokes a petition pursuant to paragraph (c)(2), the person who submitted the petition may request that a public hearing be held. The Administrator may grant the request for a public hearing if he has reason to believe that genuine and relevant factual information will be presented at such a hearing. Each hearing must be preceeded by adequate public notice, will be an informal rather than a formal hearing and will be presided over by a person named by the Administrator.

(k) The presiding officer will decide whether the Administrator's denial of the petition will stand or whether the Administrator must reconsider the petition. The decision(s) of the presiding officer at the hearing held under paragraph (j) will constitute final Agency action and cannot be appealed to the Administrator.

(l) Once an equivalent method is approved by the Administrator, any generator, treater, storer or disposer may use the equivalent method in lieu of the prescribed method(s) cited in this Part.

(m) An equivalent method may not be used to determine whether a solid waste is or is not hazardous under this Part until it is approved by the Administrator.

Part 262 - STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE

Subpart A - General

262.10 Purpose, Scope, and Applicability
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Subpart E - Special Conditions

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Appendix - Form

Annual Report (EPA Form 8700-13)

SUBPART A - GENERAL

262.10 Purpose, Scope, and Applicability

(a) These regulations establish standards for generators of hazardous waste.

(b) A generator who treats, stores, or disposes of hazardous waste on-site must comply with the applicable standards and permit requirements set forth in 40 CFR Parts 264 and 265 and 40 CFR Part 122. He must only comply with the following sections of this Part: 262.11 for determining whether or not he has a hazardous waste, 262.12 for obtaining an EPA identification number, 262.40(c) for recordkeeping, and if applicable, 262.51 for farmers.

(c) Any person who imports hazardous waste into the United States must comply with the standards applicable to generators established in this Part.

(d) Farmers must comply with all of the requirements of §262.51.

(e) A person who generates a hazardous waste as defined by 40 CFR Part 261 is subject to the compliance requirements and penalties prescribed in Section 3008 of the Act if he does not comply with the requirements of this Part.

262.11 Hazardous Waste Determination

A generator must use the following method to determine if a solid waste is a hazardous waste:

(a) Determine if the waste is listed as a hazardous waste in Subpart D of 40 CFR 261.

(b) If the waste is not listed, make a determination of whether the waste is a hazardous waste for each of the characteristics under 40 CFR 261.21(b), 261.22(b), 261.23(b), and 261.24(c) by either:

- (1) Testing the waste according to the methods established in 40 CFR 261.21(a), 261.22(a), 261.23(a), and 261.24(a) and (b); or

- (2) Declaring that the waste is hazardous based on knowledge of the hazard characteristics of the waste in light of the materials or the processes used.

262.12 EPA Identification Numbers

(a) A generator must not treat, store, dispose of, transport, or offer for transportation, hazardous waste without having received an EPA identification number from the Administrator.

(b) A generator who has not received an EPA identification number may obtain one by applying to the Administrator using EPA form 8700-12. Upon receiving the request the Administrator will assign an EPA identification number to the generator.

(c) Generators must not offer their hazardous waste to transporters or to treatment, storage, or disposal facilities who have not received an EPA identification number.

SUBPART B - THE MANIFEST

262.20 General Requirements

(a) Any generator who transports, or offers for transportation, hazardous waste for off-site treatment, storage, or disposal must prepare a manifest before movement of the waste.

(b) A generator must designate on the manifest one facility which is permitted to handle the waste described on the manifest.

(c) The generator may also designate on the manifest one alternate facility which is permitted to handle his waste in the event an emergency prevents delivery of the waste to the primary designated facility.

262.21 Required Information

(a) The manifest must contain all of the following information:

(1) A manifest document number;

(2) The generator's name, mailing address, telephone number, and EPA identification number;

(3) The name and EPA identification number of each transporter;

(4) The name, address, and EPA identification number of the designated facility and an alternate facility, if any;

(5) The description of the waste (e.g., proper shipping name, class, hazardous materials identification number, if required, and additional information) required by regulations of the U.S. Department of Transportation in 49 CFR 172.101, 172.202, and 172.203;

(6) The total quantity of each hazardous waste by units of weight or volume, and the type and number of containers.

(b) The following certification must appear on the manifest: "This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and EPA."

262.22 Number of Copies

The manifest consists of an original and at least the number of copies which will provide the generator, each transporter, and the designated facility with one copy each.

262.23 Use of the Manifest

(a) The generator or his agent must:

(1) Sign the manifest by hand;

(2) Obtain the handwritten signature of the initial transporter and date of acceptance on the manifest; and

(3) Retain one copy, in accordance with §262.40(a);

(b) The generator must give the transporter the remaining copies of the manifest.

SUBPART C - PRE-TRANSPORT REQUIREMENTS

262.30 Packaging

Before transporting or offering hazardous waste for transportation off-site, a generator must package the waste in accordance with the Department of Transportation regulations on packages under 49 CFR 173, 178, and 179;

262.31 Labeling

Before transporting or offering hazardous waste for transportation off-site, a generator must label each package in accordance with the Department of Transportation regulations on hazardous materials, under 49 CFR 172; and

262.32 Marking

Before transporting or offering hazardous waste for transportation off-site, a generator must mark each package of hazardous waste in accordance with the Department of Transportation regulations on hazardous materials under 49 CFR 172.

Before transporting or offering hazardous waste for transportation off-site, a generator must mark each package used in the transportation of hazardous waste off-site with the following words and information requirements:

> "HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal. If found, call the U.S. Environmental Protection Agency or State/Local authorities.
> Generator's EPA Identification Number
> Manifest Document Number
> This marking must be in accordance with the requirements of 49 CFR 172.304."

262.33 Placarding

Before transporting or offering hazardous waste for transportation off-site, a generator must offer the initial transporter the appropriate placard according to Department of Transportation regulations for the movement of hazardous materials under 49 CFR Part 172, Subpart F.

262.34 Accumulation Time

(a) A generator may accumulate hazardous waste on-site without a permit for 90 days or less, provided that:

   (1) All such waste is shipped off-site in 90 days or less;

   (2) The waste is placed in containers which meet the standards of §262.30;

   (3) The date upon which each period of accumulation begins is clearly marked and visible for inspection on each container;

   (4) Each container is properly labeled and marked according to §§262.31 and 262.32;

(b) Generators who accumulate hazardous waste for more than 90 days are operators of storage facilities subject to the requirements of 40 CFR Parts 264 and 265 and the permit requirements of 40 CFR Part 122.

SUBPART D - RECORDKEEPING AND REPORTING

262.40 Recordkeeping

(a) A generator must keep a copy of each manifest signed in accordance with §262.23(a) for three years or until he receives a signed copy from the designated facility which received the waste. This signed copy must be retained as a record for at least three years from the date the waste was accepted by the initial transporter.

(b) A generator must keep a copy of each Annual Report and Exception Report for a period of three years.

(c) A generator must keep records of any test results, waste analyses, or other determinations made in accordance with §262.11 for not less than three years from the date that the waste was last sent to on-site or off-site treatment, storage, or disposal.

262.41 Annual Reporting

(a) A generator who ships his hazardous waste off-site must submit Annual Reports:

(1) On EPA form 8700-13, according to the instructions on the form (see the Appendix to this Part).

(2) To the Regional Administrator for the Region in which the generator is located;

(3) No later than March 1 for the preceding calendar year;

(b) Any generator who treats, stores, or disposes of hazardous waste on-site must submit an Annual Report covering those wastes in accordance with the provisions of 40 CFR Parts 264 and 265.

262.42 Exception Reporting

(a) A generator who does not receive a copy of the manifest with the handwritten signature of the owner/operator of the designated facility or his agent within 35 days of the date the waste was accepted by the initial transporter must contact the transporter and/or the designated facility to determine the status of the movement.

(b) A generator must submit an Exception Report if he has not received a copy of the manifest with the handwritten signature of the owner/operator of the designated facility or his agent within 45 days of the date the waste was accepted by the initial transporter. The Exception Report must include:

(1) A legible copy of the manifest for which the generator does not have confirmation of delivery;

(2) A cover letter signed by the generator or his authorized representative explaining the efforts taken to locate that movement and the results of those efforts.

262.43 Additional Reporting

The Administrator, as he deems necessary under 3002(6) of the Act, may require generators to furnish additional reports concerning the quantities and disposition of wastes identified or listed in 40 CFR Part 261.

262.44 Confidentiality

All information that generators provide to EPA in accordance with this Subpart will be available to any person to the extent and in the manner authorized by Section 3007(b) of the Act, the Freedom of Information Act (FOIA), 5 U.S.C. Section 552, and EPA regulations promulgated under FOIA, 40 CFR Part 2. If a generator wishes to make a claim of business confidentiality he must do so at the time he submits the information.

SUBPART E - SPECIAL CONDITIONS

262.50 International Shipments

(a) Any person who exports hazardous waste to a foreign country or imports hazardous waste from a foreign country must comply with all the requirements of this Part and with the special requirements of this Section.

(b) When shipping hazardous waste outside the United States the generator must:

  (1) Notify the Administrator in writing two weeks before the initial shipment of hazardous waste to each country in each calendar year. The waste must be identified by its DOT shipping description.

  (2) Require that the foreign consignee confirm the delivery of the waste in the foreign country. A copy of the manifest signed by the foreign consignee may be used for this purpose.

  (3) Meet the requirements under §262.21 for the manifest for international movements, except that:

    (i) In place of the name, address, and EPA identification number of the designated facility, the name and address of the foreign consignee must be used;

(ii) The generator must identify the point of departure from the United States through which the waste must travel before entering a foreign country.

(c) A generator must comply with the Exception Report requirements of §262.42 if:

(1) He has not received a copy of the manifest signed by the transporter stating the date and place of departure from the United States within 45 days from the date it was accepted by the initial transporter; or

(2) Within 90 days from the date the waste was accepted by the initial transporter, the generator has not received written confirmation from the foreign consignee that the waste movement was received.

(d) When importing hazardous waste, a person must:

(1) Meet all requirements of §262.21 for the manifest except that:

(i) In place of the generator's name, address and EPA identification number, the name and address of the foreign generator and the importer's name, address and EPA identification number must be used.

(ii) In place of the generator's signature on the certification statement, the U.S. importer or his agent must sign and date the certification and obtain the signature of the initial transporter.

262.51 Farmers

(a) A farmer disposing only of waste pesticides from his own use which are hazardous wastes is not required to comply with the standards in this Part, provided he:

(1) Disposes of all waste pesticides in accordance with instructions on the pesticide label or, if there are no label instructions, according to the procedures and criteria specified in 40 CFR Parts 165 and 257, and

(2) Triple rinses each pesticide container after it has been emptied and uses the rinsate as makeup water in the tank mix or on crop lands at an application rate

consistent with pesticide labeling. However, the pesticide must be registered for the particular crop.

(b) A farmer who generates other hazardous wastes must comply with all the requirements of this Part with respect to those wastes.

APPENDIX - FORM

Please print or type. Form designed for elite type (12 characters/inch).

Form Approved OMB No. 158-R00XX

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE ANNUAL REPORT

(Collected under the authority of Section 3002 of RCRA.)

I. IDENTIFICATION NUMBER F … T/A C 1

OFFICIAL USE ONLY (date received & reviewer)

REVIEWER'S NAME

II. NAME OF BUSINESS

III. BUSINESS REPRESENTATIVE
A. NAME
B. TELEPHONE NUMBER (area code & no.)

IV. BUSINESS ADDRESS (street or route no., city, & zip code)

V. TYPE OF REPORT
☐ A. GENERATOR
☐ B. FACILITY
☐ C. UNMANIFESTED

VI. CLOSING DATE (list yr.)

VII. WASTE INFORMATION (continue on reverse if necessary)

IDENTIFIER	A. IDENTIFICATION NUMBER	B. INTERNATIONAL SHIPMENT (mark 'X')	C. WASTE DESCRIPTION 1. DOT HAZARD CLASS (mark 'X') a. COMBUSTIBLE	b. CORROSIVE	c. ETIOLOGIC AGENT	d. EXPLOSIVE A	e. EXPLOSIVE B	f. FLAMMABLE GAS	g. FLAMMABLE LIQUID	h. FLAMMABLE SOLID	i. IRRITATING AGENT	j. NON-FLAMMABLE GAS	k. ORGANIC PEROXIDE	l. ORM-E	m. OXIDIZER	n. POISON A	o. POISON B	p. RADIOACTIVE	2. EPA ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) (see instructions)	D. AMOUNT OF WASTE	E. UNIT OF MEASURE (enter code)	F. DENSITY (enter number)	G. HANDLING CODE (enter code(s))
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							

EPA Form 8700-13 (12-79)

Continue On Reverse

Continued From Front

NO.

VII. WASTE INFORMATION (continued from front)																							
	A.	B.	C. WASTE DESCRIPTION																	D.	E.	F.	G.
			1. DOT HAZARD CLASS (mark 'X')																2. EPA				
IDENTIFIER	IDENTIFICATION NUMBER	INTERNATIONAL SHIPMENT (mark 'X')	a. COMBUSTIBLE	b. CORROSIVE	c. ETIOLOGIC AGENT	d. EXPLOSIVE A	e. EXPLOSIVE B	f. FLAMMABLE GAS	g. FLAMMABLE LIQUID	h. FLAMMABLE SOLID	i. IRRITATING AGENT	j. NON-FLAMMABLE GAS	k. ORGANIC PEROXIDE	l. ORM-E	m. OXIDIZER	n. POISON A	o. POISON B	p. RADIOACTIVE	ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) (see instructions)	AMOUNT OF WASTE	UNIT OF MEASURE (enter code)	DENSITY (enter number)	HANDLING CODE (enter code(s))
12																							
13																							
14																							
15																							
16																							
17																							

VIII. COMMENTS

IX. CERTIFICATION

I certify under penalty of law that I have personally examined an am familiar with the information submitted in this and all attache documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe tha the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

SIGNATURE

NAME (type or print)

DATE SIGNED

EPA Form 8700-13 (12-79) REVERSE

General Instructions:

(1) Print clearly using ink or type (this form was prepared to be used with an elite (12 characters per inch) typewriter).

(2) Read all instructions before starting to complete the form.

ANNUAL REPORT FOR GENERATORS WHO SHIP HAZARDOUS WASTE OFF-SITE

Instructions:

I. IDENTIFICATION NUMBER

Enter your 12 digit EPA identification number (also enter this number in the appropriate box on the reverse of this form).

II. NAME OF BUSINESS

Enter the name of your business, organization, or agency.

III. BUSINESS REPRESENTATIVE - NAME

A. Print the first name, middle initial, and last name of the business representative who can answer questions regarding information on this form.

III. TELEPHONE NUMBER

B. Enter the phone number, including area code, for the business representative identified in III-A.

IV. BUSINESS ADDRESS

Enter the address where the hazardous waste described on this report was generated.

V. TYPE OF REPORT

Generators who ship hazardous waste off-site must put an "X" in the box labeled "GENERATOR."

VI. REPORT DATE

Enter the calendar year for which this report is submitted. The reporting year for hazardous waste shipped off-site is January 1 through December 31.

VII. WASTE INFORMATION - (for hazardous waste generated and shipped off-site during the reporting year).

Column A: Enter the 12 digit EPA identification number for the designated facility to which each hazardous waste identified in column "C" was sent. If hazardous waste was sent to the same designated facility identified on the preceding line, you may print "same" in place of the 12 digit EPA identification number.

Column B: For INTERNATIONAL SHIPMENTS sent to foreign countries mark an "X" in column "B."

Column C-1: For all hazardous waste shipped off-site put an "X" in the box (A through P) which corresponds to the appropriate DOT Hazard Class of that particular waste.

Column C-2: If four or less EPA listed wastes are included in the waste identified in column "C-1," enter the four digit EPA waste list number(s) from 40 CFR Part 261 for the listed waste(s) you identified under §262.11. If more than four EPA listed wastes are included in the waste identified in column "C-1," enter 0000 in the last four boxes and identify the fourth and subsequent EPA listed wastes and the appropriate line number in the Comments section of this report.

If the waste identified in column "C-1" is not an EPA listed waste, enter the four digit EPA Waste Characteristic Number(s). (Characteristics of hazardous waste are established in 40 CFR Part 261.)

Column D: AMOUNT OF WASTE

Enter the amount of waste described on that line under column "C-1."

Column E: Enter the code for the unit of measure for the corresponding amount entered in column "D." The units of measure which are allowed are shown in the table below:

Unit of Measure	Code	Required Density
Pounds	P	none
Short Tons	T	none
Gallons (U.S.)	G	Pounds per Gallon
Cubic Yards	Y	Tons per Cubic Yd.
Kilograms	K	none
Tonnes	M	none
Liters	L	Kilograms per Liter
Cubic Meter	C	Tonnes per Cubic Meter

Column F: (Complete this column only if the corresponding unit of measure used in column "F" was "Gallons (U.S.)," Cubic Yards, Liters, or Cubic Meters.)

Enter the appropriate density of waste described in column "C-1." If decimal points are required, use one box for the decimal. If the waste described in column "C-1" is given in units of Gallons (U.S.), Cubic Yards, Tonnes, or Liters, the density used in column "F" must be based on the corresponding "Required Density" in the table.

Column G: LEAVE BLANK

VIII. COMMENTS:

Generators who ship hazardous waste off-site must use the comments section to:

1. List the EPA identification number of each transporter whose services were utilized during the reporting year;
2. Identify the name and address of foreign treatment, storage, or disposal facilities;
3. Identify the fourth and subsequent EPA waste list numbers of five or more wastes which were mixed together to make the waste described in column "C-1";
4. Other comments as may be appropriate.

PART 263 - STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE

Subpart A - General

263.10 Scope
263.11 EPA Identification Numbers

Subpart B - Compliance with the Manifest System and Recordkeeping

263.20 Acceptance of Hazardous Waste from Generators
263.21 Compliance with the Manifest
263.22 Recordkeeping

Subpart C - Hazardous Waste Discharges

263.30 Immediate Action
263.21 Discharge Cleanup

SUBPART A - GENERAL

263.10 Scope

(a) These regulations establish standards which apply to persons transporting hazardous waste within the United States if the transportation requires a manifest under 40 CFR Part 262.

NOTE: The regulations set forth in Parts 262 and 263 establish the responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of that waste. In these regulations, EPA has expressly adopted certain regulations of the Department of Transportation (DOT) governing the transportation of hazardous materials. These regulations concern, among other things, labeling, marking, placarding, and using proper containers. EPA has expressly adopted these regulations in order to satisfy its statutory obligation to promulgate regulations which are necessary to protect human health and the environment in the transportation of hazardous waste. EPA's adoption of these DOT regulations ensures consistency with the requirements of DOT, and thus avoids the establishment of duplicative or conflicting requirements with respect to these matters. These EPA regulations which apply to both interstate and intrastate transportation of hazardous waste are enforceable by EPA.

DOT has revised its hazardous materials transportation regulations in order to encompass the transportation of hazardous waste and to regulate intrastate, as well as interstate, transportation of hazardous waste. Transporters of hazardous waste are cautioned that DOT's regulations are fully applicable to their activities and enforceable by DOT. These DOT regulations are codified in Volume 49 of the Code of Federal Regulations.

(b) These regulations do not apply to on-site transportation of hazardous waste by generators or by owners or operators of permitted hazardous waste facilities.

(c) A transporter of hazardous waste must also comply with 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste, if he:

(1) transports hazardous waste into the United States from abroad; or

(2) mixes hazardous wastes of different DOT shipping descriptions by placing them into a single container.

Note: Transporters who store hazardous waste are required to comply with the storage standards in 40 CFR Parts 264 and 265 and the permit requirements of 40 CFR Part 122.

263.11 EPA Identification Number

(a) A transporter must not transport hazardous wastes without having received an EPA identification number from the Administrator.

(b) A transporter who has not received an EPA identification number may obtain one by applying to the Administrator using EPA Form 8700-12. Upon receiving the request, the Administrator will assign an identification number to the transporter.

SUBPART B - COMPLIANCE WITH THE MANIFEST SYSTEM AND RECORDKEEPING

263.20 Acceptance of Hazardous Waste from Generators

(a) A transporter may not accept a hazardous waste movement from a generator unless it is accompanied by a manifest signed by the generator in accordance with the provisions of 40 CFR Part 262.

(b) Before transporting the movement, the transporter must sign and date the manifest acknowledging acceptance of the hazardous waste from the generator. The transporter must return a signed copy to the generator before leaving the generator's property.

263.21 Compliance with the Manifest

(a) The transporter must deliver the entire quantity of hazardous waste which he has accepted from a generator or a transporter to:

(1) the designated facility listed on the manifest; or

(2) the alternate designated facility, if the movement cannot be delivered to the designated facility; or

(3) the next designated transporter; or

(4) the point of departure from the United States, for movements that the generator has designated to a foreign consignee.

(b) If the movement cannot be delivered in accordance with subparagraph (a), the transporter must contact the generator for further directions and must revise the manifest according to the generator's instructions.

(c) Air, highway and water (excluding bulk shipments) transporters who:

- (1) deliver hazardous waste movements to another transporter must:
  - (i) obtain the signature of the next transporter; and
  - (ii) retain one copy, in accordance with §262.22; and
  - (iii) give the remaining copies of the manifest to the accepting transporter
- (2) accept hazardous waste movements from another transporter must:
  - (i) sign and date the manifest; and
  - (ii) return a signed copy to the previous transporter before transporting the movement; and
  - (iii) ensure that the manifest accompanies the movement at all times
- (3) deliver movements to the designated facility must:
  - (i) obtain the signature of the owner or operator of the designated facility on the manifest; and
  - (ii) retain copy of the manifest in accordance with §263.22; and
  - (iii) give the remaining copies to the designated facility.

(d) Rail and water (bulk shipments) transporters who:

- (1) deliver hazardous waste movements to a transporter of another mode must:
  - (i) obtain the signature of the accepting transporter on the manifest; and

(ii) retain one copy of the manifest in accordance with §263.22; and

(iii) give the remaining copies to the accepting transporter

(2) accept hazardous waste movements from a generator or a transporter of another mode must:

(i) sign and date the manifest; and

(ii) return a signed copy to the generator or previous transporter before transporting the movement; and

(iii) forward or carry the manifest signed by the generator, the previous transporter(s) and himself to:

(A) the transporter of the next mode, if the movement is transferred to another mode; or

(B) the designated facility, if the movement is delivered by rail or water directly to the facility

(iv) ensure that the information contained on the manifest (excluding EPA identification codes, generator certification, and signatures) accompanies the movement at all times

(3) accept hazardous waste movements from a transporter of the same mode must:

(i) ensure that the information contained on the manifest (excluding EPA identification codes, generator certification, and signatures) accompanies the movement at all times

(4) deliver hazardous waste movements to the designated facility must:

(i) obtain the signature of the owner or operator of the designated facility on the manifest; and

(ii) retain one copy, in accordance with §263.22; and

(iii) give the remaining copies of the manifest to the owner or operator of the designated facility.

(e) Transporters who transport movements out of the United States must:

(1) indicate on the manifest the date the movement left the United States;

(2) sign the manifest and retain one copy in accordance with 263.22(c); and

(3) return a signed copy of the manifest to the generator within 30 days of the date the waste was accepted by the initial transporter.

263.22 Recordkeeping

Transporters of hazardous waste must keep the following records for a period of three years from the date the movement was accepted by the inital transporter.

(a) Air, highway, and water (excluding bulk shipments) transporters must keep a copy of the manifest signed by the generator, himself, and the next designated transporter or the owner/operator of the designated facility or his agent.

(b) For rail and water (bulk shipments) transporters:

(1) the rail and water (bulk shipment) transporter accepting the movement from a generator or a transporter of another mode must keep copy of the manifest signed by the generator, the previous transporter, and himself.

(2) the final rail or water (bulk shipments) transporter must keep a copy of the manifest signed by:

(i) the next transporter, if the waste movement is transferred to another mode; or

(ii) the owner/operator of the designated facility or his agent, if the waste movement is delivered by rail or water to the facility.

(3) intermediate rail or water (bulk shipments) transporters must keep a copy of any shipping paper (waybill, dangerous cargo manifest, or other shipping document)

which contains the information required on the manifest (excluding EPA identification numbers, generator certification, and signatures).

(c) Transporters who transport movements out of the United States must keep a copy of the manifest indicating that the movement left the United States.

SUBPART C - HAZARDOUS WASTE DISCHARGES

263.30 Immediate Action

(a) In the event of a discharge of hazardous waste during transportation, the transporter must take appropriate immediate action to minimize the threat to human health and the environment (e.g, notify local authorities, dike the spill area).

(b) If a discharge of hazardous waste requires its immediate removal to protect human health or the environment (as determined by EPA, other Federal Agencies, or State or local officials), the requirements of this section apply in lieu of §263.11, .20, .21, and .22, of this Part, until the discharged hazardous waste no longer presents an immediate hazard to human health or the environment (as determined by EPA, other Federal Agencies, or State or local officials).

(c) Air, rail, highway, and water (excluding bulk shipments) transporters who have discharged hazardous waste must:

(1) give notice, if required by 49 CFR 171.15, to the National Response Center (800-424-8802 or in the District of Columbia, 426-2675); and

(2) report in writing as required by 49 CFR 171:16 to the Director, Office of Hazardous Materials Regulations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

(d) Water (bulk shipments) transporters who have discharged hazardous waste must give notice as required by 33 CFR 153.203 to the National Response Center (800-424-8801 or in the District of Columbia 426-2675) or any other listed official.

263.31 Discharge Cleanup

The transporter must clean up all the discharged hazardous waste or take any action that may be required by Federal, State, or local officials so that the discharged hazardous waste no longer presents a hazard to human health or the environment.

Part 264 - STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

Subpart A - General

264.1 Purpose, Scope and Applicability
264.2 [Reserved]
264.3 Relationship to Interim Status Standards
264.4 - 264.9 [Reserved]

Subpart B - General Facility Standards

264.10 Applicability
264.11 Identification Number
264.12 Required Notices
264.13 General Waste Analysis
264.14 Security
264.15 General Inspection Requirements
264.16 Personnel Training
264.17 - 264.29 [Reserved]

Subpart C - Preparedness and Prevention

264.30 Applicability
264.31 Design and Operation of Facility
264.32 Required Equipment
264.33 Testing and Maintenance of Equipment
264.34 Access to Communication or Alarm System
264.35 Required Aisle Space
264.36 Special Handling for Ignitable and Reactive Waste
264.37 Arrangements with Local Authorities
264.38 - 264.49 [Reserved]

Subpart D - Contingency Plan and Emergency Procedures

264.50 Applicability
264.51 Purpose and Implementation of Contingency Plan
264.52 Content of Contingency Plan
264.53 Copies of Contingency Plan
264.54 Amendment of Contingency Plan
264.55 Emergency Coordinator
264.56 Emergency Procedures
264.57 - 264.69 [Reserved]

Subpart E - Manifest System, Recordkeeping and Reporting

264.70 Applicability
264.71 Use of Manifest System
264.72 Manifest Discrepancies
264.73 Operating Record
264.74 Disposition of Records
264.75 Annual Report
264.76 Unmanifested Waste Report
264.77 Additional Reports
264.78 - 264.89 [Reserved]

Subpart F - Ground-Water Monitoring

264.90 Applicability
264.91 Ground-Water Monitoring System
264.92 Sampling and Analysis
264.93 Preparation, Evaluation, and Response
264.94 Recordkeeping and Reporting
264.95 - 264.109 [Reserved]

Subpart G - Closure and Post-Closure

264.110 Applicability
264.111 Closure Performance Standard
264.112 Closure Plan; Amendment of Plan
264.113 Time Allowed for Closure
264.113 Time Allowed for Closure
264.114 Disposal or Decontamination of Equipment
264.115 Notification and Certification of Closure
264.116 [Reserved]
264.117 Post-Closure Care and Use of Property; Period of Care
264.118 Post-Closure Plan; Amendment of Plan
264.119 Notice to Local Land Authority
264.120 Notice in Deed to Property
264.121 - 264.999 [Reserved]

Appendices

Appendix I - Recordkeeping Instructions
Appendix II - EPA Report Form and Instructions
Appendix III - EPA Interim Primary Drinking Water Standards
Appendix IV - Tests for Significance

SUBPART A - GENERAL

264.1 Purpose, Scope, and Applicability

(a) The purpose of this Part is to establish minimum national standards which define the acceptable management of hazardous waste. These standards apply to owners and operators of facilities which treat, store, and dispose of hazardous waste.

(b) The requirements of this Part do not apply to the following:

(1) Disposing of hazardous waste by means of underground injection, under Safe Drinking Water Act (SDWA) regulations (except that these Part 264 regulations do apply to the above-ground treatment and/or storage of hazardous waste before it is injected underground);

(2) Disposing of hazardous waste by means of ocean disposal under Marine Protection, Research, and Sanctuaries Act (MPRSA) regulations (except that these Part 264 regulations do apply to the treatment and/or storage of hazardous waste before it is loaded onto an ocean vessel to be incinerated or disposed at sea); and

(3) Treating, storing, and/or disposing of any of the wastes specified in §261.4.

(c) An owner/operator of a publicly owned treatment works (POTW) that receives hazardous waste by truck or rail is exempt from all requirements of this Part, except the requirements of §§264.71, 264.72, 264.75, and 264.76.

(d) The Regional Administrator will use the requirements of this Part as the basis for bringing enforcement actions pursuant to Section 3009 of the Act against the owner/operator of a facility that does not have a permit or a pending permit application.

(e) In instances where those portions of a facility at which waste management activities took place before the effective date of these Part 264 regulations could potentially interfere with the monitoring and/or control of portions subject to his Part, the Regional Administrator may require the owner/operator to comply with one or more of the requirements of the following Sections of this Part for those portions of the facility at the time of issuance of a permit under Part 122, Subparts A and B:

264.14 - Security
264.15 - Inspections
Subpart D - Contingency Plan and Emergency Procedures
Subpart F - Ground-Water Monitoring
Subpart G - Closure and Post-Closure

264.2 [Reserved]

264.3 Relationship to Interim Status Standards

A facility owner/operator who has fully complied with the requirements for interim status as defined in Section 3005(e) of the Act and regulations under 40 CFR Part 122.23(a) must comply with the regulations specified in Part 265 in lieu of the regulations in this Part, until final administrative disposition of his permit application is made.

> Comment: As stated in Section 3005(a) of RCRA, upon and after the effective date of regulations under that Section, i.e., 40 CFR Part 122 regulations, the treatment, storage, and disposal of hazardous waste is prohibited except in accordance with a permit. Section 3005(e) provides for the continued operation of an existing facility which meets certain conditions until final administrative disposition of the owner's/operator's permit application is made.

264.4 - 264.9 [Reserved]

SUBPART B - GENERAL FACILITY STANDARDS

264.10 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §264.1.

264.11 Identification Number

Every facility owner/operator must apply to EPA for an identification number in accordance with the EPA notification procedures (--FR -------), except as provided otherwise in 264.1(b).

264.12 Required Notices

(a) An owner/operator of a facility that has arranged to receive hazardous waste from foreign sources must notify the Regional Administrator in writing at least two weeks in advance of the expected date of arrival of these shipments at the facility.

(b) An owner/operator of a facility that receives hazardous waste from off-site (except when the owner/operator is also the generator) must inform the generator in writing that he has the appropriate permit(s) for and will accept the waste the generator is shipping. A copy of this written notice must be retained by the owner/operator as part of the record of waste received.

(c) Before transferring ownership or operation of a facility during its operating life, or a disposal facility during the post-closure care period, the owner or operator must notify the new owner or operator in writing of the requirements of this Part.

264.13 General Waste Analysis

(a) (1) Before an owner/operator manages any hazardous waste, he must obtain a detailed chemical and physical analysis of the waste. At a minimum, this analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with the requirements of this Part or with the conditions of a permit issued under Part 122, Subparts A and B.

(2) The analysis may include data developed pursuant to Part 261, and existing data on the waste which is published or documented (e.g., the facility's records of analyses performed on the waste prior to the effective date of the regulations, studies conducted on waste generated from processes similar to that which generated the waste to be managed at the facility, etc.)

(3) The analysis must be conducted in accordance with and repeated at the frequency specified in the waste analysis plan required in paragraph (b) below. At a minimum, the analysis must be repeated when the owner/operator is notified, or has reason to believe, that the process or operation generating the waste has changed, and for off-site facilities, when the results of the tests required in paragraph (a)(4) below indicate that the composition or the characteristics of the waste received at the facility do not match the waste designated on the accompanying manifest.

(4) For off-site facilities, owners/operators must determine whether the waste shipments received at the facility match the identity of the waste specified in the accompanying manifest.

Comment: The owner/operator of an off-site facility may make an arrangement with the generator of the waste to supply part of the required information. If the generator does not supply the information, and the owner/operator chooses to accept a waste, he is responsible for obtaining the information required to comply with this Section.

(b) Owners/operators must develop a waste analysis plan which describes the procedures which the owner/operator will carry out to comply with paragraph (a). At a minimum, the plan must specify the following:

(1) The parameters for which each waste will be analyzed and the rationale for the selection for these parameters (i.e., how analysis for these parameters will provide sufficient information on the waste's properties to comply with paragraph (a));

(2) The test methods which will be used to test for these parameters;

(3) The sampling methodology which will be used to obtain a representative sample of the waste to be analyzed (see Appendix I of Part 261 for EPA-approved sampling methods);

(4) The frequency at which the initial analysis of the waste will be reviewed and/or repeated to ensure that the analysis is accurate and up to date; and

(5) For off-site facilities, the waste analyses that waste generators have agreed to supply.

(c) For off-site facilities, the waste analysis plan required in paragraph (b) must also specify the procedures which will be implemented to ensure that the shipments of waste received at the facility match the identity of the waste designated on the accompanying manifest. At a minimum, the plan must describe the following:

(1) The tests which will be used to determine the identity of each shipment of waste managed at the facility; and

(2) The sampling methodology which will be used to obtain a representative sample of the waste to be identified.

Comment: Part 122, Subpart B, requires that the waste analysis plan be submitted with Part B of the permit application.

264.14 Security

(a) A facility owner/operator must prevent the unknowing entry, and minimize the possibility for the unauthorized entry, of persons or livestock onto the active portion of his facility, unless he can demonstrate to the Regional Administrator that:

(1) Physical contact with the waste, structures, or equipment within the active portion of the facility will not injure unknowing and/or unauthorized persons or livestock which may enter the active portion of a facility, and

(2) Disturbance of the waste or equipment, by the unknowing and/or unauthorized entry of persons or livestock onto the active portion of a facility, will not endanger human health or the environment.

Comment: Part 122, Subpart B, requires that an owner/operator who wishes to make the demonstration referred to above must do so with Part B of the permit application.

(b) To ensure compliance with paragraph (a), owners/operators must demonstrate that their facilities have:

(1) A 24-hour surveillance system (e.g., television monitoring of the active portion and/or surveillance of the active portion by guards or facility personnel)

which continuously monitors and controls entry onto the active portion of the facility; or

(2) (i) An artificial and/or natural barrier (e.g., a fence in good repair and/or a cliff) which completely surrounds the active portion of the facility; and

(ii) A means to control entry through the gates or other entrances to the active portion of the facility (e.g., an attendant, television monitors, locked entrance, controlled roadway access to the facility) both during the facility's operating hours and when the facility is unattended.

The requirements of paragraph (b) are satisfied if the facility or plant within which the active portion is located itself has a surveillance system or a barrier and a means to control entry which complies with the requirements of paragraph (b)(1) or (2).

(c) To ensure compliance with paragraph (a), a sign with the following legend, "Warning - Unauthorized Personnel Keep Out," must be posted at each entrance to the active portion of a facility and in sufficient numbers to be seen from any approach to the active portion of a facility. The legend must be written in English and in any other language predominant in the area surrounding the facility (e.g., facilities in counties bordering the Canadian province of Quebec must post signs in French; facilities in counties bordering Mexico must post signs in Spanish) and must be legible from a distance of at least 25 feet. Existing signs with a legend other than "Warning--Unauthorized Personnel Keep Out" may be used if the legend on the sign indicates that only authorized personnel are allowed to enter the active portion, and that entry onto the active portion is potentially dangerous.

Comment: Owners/operators are encouraged to also describe on the sign the type of hazard (e.g., hazardous waste, flammable waste, etc.) contained within the active portion of the facility.

Comment: See §264.117(b) for discussion of security requirements at disposal facilities during the post-closure care period.

264.15 General Inspection Requirements

(a) Facility owners/operators must inspect facilities for equipment malfunctions and deterioration, operator errors, and spills, which may be causing or may lead to release of hazardous constituents to the environment or pose a threat to human health outside the facility. These inspections must be conducted frequently enough to identify problems in time to take corrective action before they harm human health or the environment.

(b) Facility owners/operators must develop and implement a schedule for inspecting monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment (such as dikes and sump pumps) that are important to the prevention and detection of, or response to, environmental or human health hazards. The schedule must identify the types of problems (e.g., malfunctions or deterioration) which are to be looked for during the inspection (for example, inoperative sump pump, leaking fitting, eroding dike, etc.). The frequency of inspection may vary for the items on the schedule, but should be based on the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when they are in use.

Comment: Part 122, Subpart B, requires the inspection schedule to be submitted with Part B of the permit application. EPA will evaluate the schedule along with the rest of the application to ensure that it adequately protects human health and the environment. As part of this review, EPA may modify or amend the schedule as may be necessary.

(c) The owner/operator must make any repairs, or take other remedial action, on a time schedule which ensures that any deterioration or malfunction discovered does not lead to an environmental or human health hazard. Where an incident is imminent or has already occurred, remedial action must be taken immediately.

(d) The owner/operator must keep records of inspections in an inspection log or summary. These records must be retained for at least three years. At a minimum, these records must include the date and time of the inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs made or remedial actions taken.

264.16 Personnel Training

(a) (1) Facility personnel must successfully complete a program of instruction and/or on-the-job training that teaches them to perform their duties in a way that ensures the facility's compliance with the requirements of this Part and that includes all the elements described in paragraph (a)(3) below.

(2) This program must be directed by a person trained in hazardous waste management procedures, and must include instruction, supplementing the facility personnel's existing job knowledge, which teaches facility personnel hazardous waste management procedures (including contingency plan implementation) relevant to the positions in which they are employed.

(3) At a minimum, the training program must be designed to ensure that facility personnel are able to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency systems, including, but not necessarily limited to, the following, where applicable:

(i) Procedures for inspection, repair, and replacement of facility emergency and monitoring equipment;

(ii) Key parameters for automatic waste feed cutoff systems;

(iii) Communications and/or alarm systems;

(iv) Response to fires or explosions;

(v) Response to ground-water contamination incidents; and

(vi) Shutdown of operations.

(b) Facility personnel must successfully complete the program required in paragraph (a) within six months after the effective date of these regulations or six months after the date of employment or assignment to a facility, or a new position at a facility, whichever is later. New employees must not work in unsupervised positions until they have completed the training requirements of paragraph (a).

(c) Facility personnel must take part in an annual review of their initial training in both contingency procedures and the hazardous waste management procedures relevant to the positions in which they are employed.

(d) Owners/operators of facilities must maintain the following documents and records and make them available to the Regional Administrator upon request:

(1) The job title for each position at the facility related to hazardous waste management, and the name of the employeee filling each job;

(2) A written job description for each position listed under paragraph (d)(1). This description may be consistent in its degree of specificity with descriptions for other similar positions in the same company location or bargaining unit, but must include the requisite skill, education, or other qualifications, and duties of employees assigned to each position;

(3) A written description of the type and amount of both introductory and continuing training that will be given to each person filling a position listed under paragraph (d)(1);

(4) Records that document that the training or job experience required under paragraphs (a), (b), and (c) has been given to, and completed by, facility personnel.

(e) Training records on current employees must be maintained until closure of the facility; training records on former employees must be retained for at least three years. Employee training records may accompany personnel transferred within the same company.

SUBPART C - PREPAREDNESS AND PREVENTION

264.30 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §264.1.

264.31 Design and Operation of Facility

Facilities must be designed, constructed, maintained, and operated so that the possibility of a discharge, fire, or explosion which could threaten the environment or human health outside the facility is minimized.

264.32 Required Equipment

All facilities must be equipped with the following, unless it can be demonstrated to the Regional Administrator that there are no hazards at the facility which could require a particular kind of equipment specified below:

(a) An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility employees;

(b) A device capable of summoning external emergency assistance from local police departments, fire departments, or State or local emergency response teams, such as a telephone (immediately available at the scene of operation) or a handheld two-way radio;

(c) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment; and

(d) Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.

Comment: Part 122, Subpart B, requires that an owner/operator who wishes to make the demonstration referred to above must do so with Part B of the permit application.

264.33 Testing and Maintenance of Equipment

All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.

264.34 Access to Communication or Alarm System

(a) Whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all employees involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless the Regional Administrator has ruled that such a device is not required under §264.32 above.

(b) If there is ever just one employee on the premises while the facility is operating, he must have immediate access to a device capable of summoning external emergency assistance, such as a telephone (immediately available at the scene of operation), or a hand-held two-way radio, unless the Regional Administrator has ruled that such device is not required under §264.32 above.

264.35 Required Aisle Space

The facility owner/operator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless it can be demonstrated to the Regional Administrator that aisle space is not needed for any of these purposes.

Comment: Part 122, Subpart B, requires that an owner/operator who wishes to make the demonstration referred to above must do so with Part B of the permit application.

264.36 Special Handling for Ignitable and Reactive Waste

The facility owner/operator must take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. This waste must be separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), spontaneous ignition (e.g., from heat-producing chemical reactions), and radiant heat. While ignitable or reactive waste is being handled, the facility owner/operator must confine smoking and open flame to specially designated locations. "No Smoking" signs must be conspicuously posted wherever there is normally a hazard from ignitable or reactive waste.

264.37 Arrangements with Local Authorities

Analogue to 264.52(b) to be added here

264.38 - 264.49 [Reserved]

SUBPART D - CONTINGENCY PLAN AND EMERGENCY PROCEDURES

264.50 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §264.1.

264.51 Purpose and Implementation of Contingency Plan

(a) The owner/operator must develop a contingency plan for each facility designed to minimize human health and environmental damage in the event of an unplanned sudden or non-sudden discharge of hazardous waste to air, soil, or surface water.

(b) The provisions of the plan must be implemented immediately whenever there is a discharge of hazardous waste which could threaten the environment or human health outside the facility.

264.52 Content of Contingency Plan

(a) The plan must include provisions for controlling spills. If a facility owner/operator already has prepared a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with 40 CFR 112 and/or 40 CFR 151, or some other emergency or contingency plan, he need only amend that plan to incorporate hazardous waste management provisions sufficient to comply with the requirements of this Part.

(b) The plan must describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services, where these arrangements are appropriate for the type of waste handled at the facility or the potential need for the services of these organizations. Facility owners/operators must attempt to make the following arrangements, as appropriate, to the type of waste handled at their facility. Where State or local authorities decline to enter into such arrangements, the facility owner/operator must document the refusal in writing.

(1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to and roads inside the facility, and possible evacuation routes;

(2) In the event that more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority; and

(3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers.

(c) The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as facility emergency coordinator (see §264.55), and this list must be kept up to date. Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates. For new facilities, this information must be supplied to the Regional Administrator before operations begin at the time of certification, rather than at the time of permit application.

(d) The plan must include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.

(e) The plan must include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must outline signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by discharges of hazardous waste or fires).

264.53 Copies of Contingency Plan

A copy of the contingency plan and all revisions to the plan must be:

(a) Maintained at the facility;

(b) Made available to the Regional Administrator upon request; and

(c) Submitted to all local police departments, fire departments, hospitals, and emergency response teams that may be called upon to provide emergency services.

Comment: The contingency plan must be submitted to the Regional Administrator with Part B of the permit application under Part 122, Subparts A and B, and after modification and/or approval, will become a condition of any permit issued.

264.54 Amendment of Contingency Plan

The contingency plan must be reviewed, and immediately amended, if necessary, under any of the following circumstances:

(a) Revisions to the facility permit;

(b) Failure of the plan in an emergency;

(c) Changes in the facility design, construction, operation, maintenance, or other circumstances that materially increase the potential for discharges of hazardous waste or change the response necessary in an emergency;

(d) Changes in the list of emergency coordinators; or

(e) Changes in the list of emergency equipment.

Comment: A change in the lists of facility emergency coordinators or equipment in the contingency plan does not constitute an amendment to the facility permit to which the plan is a condition.

264.55 Emergency Coordinator

Whenever the facility is in operation, there must be at least one employee either present or on call (i.e., available to respond even though not on the facility premises) with the responsibility for coordinating all emergency response measures. This facility emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of manifests within the facility, if applicable, and the facility layout. In addition, this person must have the authority to commit the resources needed to implement the contingency plan.

Comment: The emergency coordinator's responsibilities are more fully spelled out in §254.56 below. Applicable responsibilities for the emergency coordinator vary, depending on factors such as type and variety of waste(s) handled by the facility, and type and complexity of the facility.

264.56 Emergency Procedures

(a) The facility's emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:

(1) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel of any imminent or actual emergency situation, and

(2) Notify appropriate State or local agencies with designated response roles whenever their assistance is needed.

(b) In the event of a discharge, fire, or explosion, the facility's emergency coordinator must immediately identify the character, exact source, amount, and area of any discharged materials. He may do this by observation and/or review of facility records or manifests, and, if necessary, by chemical analysis.

(c) The facility's emergency coordinator must immediately assess possible hazards to the environment and human health outside the facility that may result from discharge, fire, or explosion. This assessment must consider both direct and indirect effects of the discharge, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water runoff from water or chemical agents used to control fire and heat-induced explosions).

(d) The facility's emergency coordinator must immediately report his assessment that the facility has had a discharge, fire, or explosion which could threaten the environment or human health outside the facility, as follows:

(1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to assist appropriate officials in making the decision whether local areas should be evacuated;

(2) He must immediately notify either the government official designated as the on-scene coordinator for that geographical area (in the applicable regional contingency plan under 40 CFR 1510) or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include:

(i) Name and telephone number of reporter;

(ii) Name and address of facility;

(iii) Time and type of incident (e.g., disharge, fire);

(iv) Name and quantity of material(s) involved, to the extent available; and

(v) The extent of injuries, if any.

(e) During an emergency, the facility's emergency coordinator must take all reasonable measures necessary to ensure that fires and explosions do not occur, recur, or spread to other hazardous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting and containing discharged waste, and removing or isolating containers.

(f) If the facility stops operations in response to a discharge, fire, or explosion, the facility's emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.

(g) Immediately after an emergency, the facility's emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a discharge, fire, or explosion at the facility. The recovered material must be handled as a hazardous waste unless it is analyzed and determined not to be, using the procedures specified in Part 261.--.

(h) The facility's emergency coordinator must ensure that, in the affected area(s) of the facility:

(1) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and

(2) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.

(i) The facility owner/operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with paragraph (h) above before operations are resumed in the affected area(s) of the facility.

(j) The facility owner/operator must record the time, date, and nature of any emergency. Within 15 days after the emergency, he must submit a written report on the emergency to the Regional Administrator. The report must inclued:

(1) Name, address, and telephone number or the owner/operator;

(2) Name, address, and telephone number of the facility;

(3) Date, time, and type of incident (e.g., fire, discharge);

(4) Name and quantity of material(s) involved;

(5) The extent of injuries, if any;

(6) An assessment of possible hazards to the environment and human health outside the facility, where this is applicable; and

(7) Estimated quantity and disposition of recovered material that results from the incident.

264.57 - 254.69 [Reserved]

SUBPART E - MANIFEST SYSTEM, RECORDKEEPING, AND REPORTING

264.70 Applicability

The regulations in this Subpart apply to owners and operators of both on-site and off-site facilities, except as provided otherwise in §264.1; §§264.71, 264.72, and 264.76 do not apply to owners and operators of on-site facilities that do not receive any hazardous waste from off-site sources.

264.71 Use of Manifest System

An owner/operator, or his agent, of a facility that receives hazardous waste accompanied by a manifest must:

(a) Sign and date each copy of the manifest to certify that the movement covered by the manifest has been received.

(b) Where he discovers significant discrepancies in the movement (as defined in §264.72), note them in the comment section of each copy of the manifest (see §264.13(a) for waste analysis requirement).

(c) Immediately provide the transporter with at least one copy of the manifest.

(d) Within 30 days of the delivery, forward the manifest to the generator.

(e) Retain for at least three years a copy of each manifest with the certifications of the generator, transporter(s), and owner/operator of the facility, or their agents.

264.72 Manifest Discrepancies

(a) Manifest discrepancies are differences between the quantity and/or type of hazardous waste designated on the manifest, and the quantity and/or type of hazardous waste actually received. Significant discrepancies in quantity are variations greater than actually received. Significant discrepancies in quantity are variations greater than 10 percent of the shipment. Significant discrepancies in type are obvious differences which can be discovered by inspection or waste analysis, such as waste solvent substituted for waste acid.

(b) Upon discovery of a significant discrepancy in a manifest, the owner/operator must attempt to reconcile the discrepancy by telephone conversations with the waste generator and/or transporter(s), or by other means. If the discrepancy is not resolved within 15 days of receipt of the waste, the owner/operator must immediately submit a letter report, including a copy of the manifest at issue, to the Regional Administrator.

264.73 Operating Record

(a) An owner/operator of a facility must keep an operating record. This record must be open at all reasonable times for inspection by any duly authorized employee or agent of EPA.

(b) The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility.

(1) A description and the quantity of each hazardous waste received, and the method(s) and date(s) of its treatment, storage, and/or disposal at the facility (see Appendix I for further instructions).

(2) The location and quantity of each hazardous waste within the facility. For disposal facilities, the location and quantity of each hazardous waste must be recorded on a map or diagram of each cell, trench, or disposal area (see §264.119). All the above information must include cross-references to specific manifest document numbers, if the waste was accompanied by a manifest;

(3) Waste analyses performed as specified in §264.13, and the results obtained;

(4) Summary reports and records of all incidents that require implementing the contingency plan as specified in §264.56(j);

(5) Records and results of inspections as required by §264.15(d) (except these data need be kept only three years); and

(6) Monitoring data, if required by §264.90.

Comment: Monitoring data at disposal facilities also must be kept throughout the post-closure period. See §264.94(a).

264.74 Disposition of Records

Records of waste disposal locations required to be maintained under §264.73(b)(2) must be turned over to the Regional Administrator and local land authority upon closure of the facility (see §264.119).

264.75 Annual Report

Owners/operators of facilities that treat, store, or dispose of hazardous waste must prepare and submit a single copy of an annual report to the Regional Administrator by March 1 of each year. The annual report must cover facility activities during the previous calender year and must include the following information (see Appendix II for the report form):

(a) The EPA identification number, name, and address of the facility;

(b) The calendar year covered by the report;

(c) For off-site facilities, the identification number of each hazardous waste generator from which a hazardous waste was received during the year; for international shipments, the name and address of the foreign generator must be given;

(d) A description and the quantity of each hazardous waste received by the facility during the year. For off-site facilities, this information must be listed by identification number of each generator;

(e) The method(s) of treatment, storage, or disposal for each hazardous waste;

(f) Monitoring data, where required under §264.94(b)(2) and (3); and

(g) A certification signed by the owner/operator of the facility or his authorized representative.

264.76 Unmanifested Waste Report

If a facility accepts for treatment, storage, or disposal any hazardous waste from off-site sources without an accompanying manifest (except for shipments that do not require a manifest because of the exclusions in §261.4), the owner/operator must prepare and submit a single copy of a report to the Regional Administrator within 15 days of the receipt of the waste. The report must include the following information, if available (see Appendix II for the report form):

(a) The EPA identification number, name, and address of the facility;

(b) The date of receipt of the waste;

(c) The word "unmanifested" under the comments section (or check appropriate box) of the report form;

(d) The identification number, name, and address of the generator, or else the transporter;

(e) A description and the quantity of each unmanifested hazardous waste received by the facility;

(f) The method(s) of treatment, storage, or disposal for each hazardous waste;

(g) A certification signed by the owner/operator of the facility or his authorized representative; and

(h) A brief explanation of why the shipment was unmanifested in the comments section of the report form.

264.77 Additional Reports

In addition to the annual and unmanifested waste reporting requirements described in §§264.75 and 264.76, a facility owner/operator must also report to the Regional Administrator:

(a) Discharges, fires, and explosions as specified in §264.56(j);

(b) Ground-water contamination and monitoring data as specified in §§264.93 and 264.94;

(c) Before facility closure as specified in §264.115; and

(d) Upon his request, such information as the Regional Administrator may deem necessary to determine compliance with the requirements of this Part.

264.78 - 264.89 [Reserved]

SUBPART F - GROUND-WATER MONITORING

264.90 Applicability

(a) An owner/operator of a surface impoundment, landfill, or land treatment facility must install, maintain, and operate a ground-water monitoring system as specified in this Subpart, and must comply with the sampling, analysis, recordkeeping, and reporting requirements of this Subpart. However, a lesser degree of ground-water monitoring (or no monitoring) may be acceptable if the owner/operator can demonstrate to the Regional Administrator that there is a low (or no) potential for migration of hazardous waste constituents to an Underground Source of Drinking Water (USDW), to water supply wells, or to surface water via the uppermost aquifer, during the active facility life and post-closure care period. This demonstration must be certified by a qualified geologist or geotechnical engineer and must address the following:

(1) Whether or not the uppermost aquifer is a USDW, and if not, whether there is a potential for migration via the uppermost aquifer to a USDW or surface water;

(2) A thorough hydrogeologic investigation, based on but not limited to evaluations of logs of test borings made by a geologist present during drilling, which established:

(i) Unsaturated zone characteristics (i.e., geologic materials, physical properties, and depth to ground water); and

(ii) Saturated zone characteristics (i.e., geologic materials, physical properties, and rate of ground-water flow);

(3) A water balance of precipitation, evapotranspiration, runoff, and infiltration; and

(4) Proximity to water supply wells and use of water.

Comment: Part 122, Subpart B, requires that an owner/operator who wishes to make the demonstration referred to above must do so with Part B of the permit application.

(b) An owner/operator of a tank may be required by the Regional Administrator to comply with all or part of the ground-water monitoring requirements of this Subpart if the Regional Administrator determines that there is a high potential for discharge of hazardous waste constituents to ground water. The Regional Administrator will use the following criteria in making this determination:

(1) The ability of the owner/operator to detect leakage by visual inspection;

(2) The permeability of the underlying continuous base, if there is one; and

(3) The ability of the tank to contain the waste.

264.91 Ground-Water Monitoring System

(a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of:

(1) Enough monitoring wells (no less than one) located hydraulically upgradient from the limit of the waste management area and installed so as to yield ground-water samples that are

(i) representative of uncontaminated, background ground-water quality, and

(ii) not contaminated by the facility; and

(2) Enough monitoring wells (no less than three) installed hydraulically downgradient at the limit of the waste management area so that their number, locations, and depths will ensure that any hazardous waste constituent will be detected upon migration from the waste management area.

(b) (1) The distance measured in the direction of ground-water flow between the downgradient monitoring wells and the property boundary, considering the frequency of ground-water monitoring, must allow enough time to prevent contamination of ground water beyond the property boundary by implementing the corrective action program required by §264.93(b).

(2) The distance from downgradient monitoring wells to the facility property boundary must be greater than "D" in the following equation:

$D = TV$ where

D - Distance (ft) ground water moves in time T,
$T - T1 + T2 + T3$

Where

$T1$ = Time (days) between sampling (sample interval), not to exceed six months as required by 264.92(d)(2),

$T2$ = Time (days) estimated for sample analysis and evaluation,

$T3$ = Time (days) estimated in §264.93(a) and (b) for completion of the damage assessment program and corrective action programs, respectively, and

V = Velocity of ground-water flow determined by direct field measurement (ft/day) or calculated by use of the equation $V = Ki/Sy$

Where

K = Maximum hydraulic conductivity ($ft^3/day/ft^2$) of the aquifer beneath the facility,

f = Maximum hydraulic gradient (ft/ft) of the aquifer beneath the facility, and

Sy = Specific yield (ft^3/ft^3) of the aquifer beneath the facility.

(c) All monitoring wells must be cased to enable sample collection at depths where appropriate aquifer flow zones exist, and must be screened or perforated and packed with gravel or sand at these depths, where necessary. The annular space above the sampling depth must be sealed with a suitable material (e.g., cement, grout or bentonite slurry) to prevent contamination of samples and the ground water.

264.92 Sampling and Analysis

(a) The owner/operator must analyze samples from the installed ground-water monitoring system. Ground-water sampling and analysis procedures must be established and must include techniques for:

(1) Sample collection,
(2) Sample preservation and shipment,

(3) Analytical procedures, and
(4) Chain of custody control.

Comment: See "Procedures Manual for Ground-water Monitoring At Solid Waste Disposal Facilities," EPA-530/SW-611, August 1977, and "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1979, for discussions of appropriate sampling and analysis procedures.

(b) The owner/operator must determine the concentration of the following in ground-water samples in accordance with paragraphs (c) and (d):

(1) Parameters characterizing the suitability of the ground water as a drinking water supply, as specified in Appendix III.

(2) Parameters establishing ground-water quality:

(i) Chloride
(ii) Iron
(iii) Manganese
(iv) Phenols
(v) Sodium
(vi) Sulfate

Comment: These parameters are to be used as a basis for comparison in the event a damage assessment is required under §264.93(f).

(3) Parameters used as indicators of ground-water contamination:

(i) pH
(ii) Specific Conductance
(iii) Total Organic Carbon
(iv) Total Organic Halogen

(c)(1) Initial background concentrations of all parameters specified in paragraph (b) must be established for all monitoring wells quarterly for a period of one year; for new facilities this must be done quarterly for the two quarters preceding acceptance of

(2) Establishment of initial background for the indicator parameters specified in paragraph (b)(3) must include, for each indicator parameter, determination of the arithmetic mean and variance of the analytic data, by

pooling the respective analytic data for samples obtained from all wells.

(d) All monitoring wells must be sampled and the samples analyzed according to the following frequencies:

(1) Samples collected to indicate ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) at least annually.

(2) Samples collected to check for ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) at least semi-annually or according to time T1 of §264.91 (b)(2), whichever is most frequent.

(e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.

264.93 Preparation, Evaluation, and Response

(a) The owner/operator must prepare an outline of and time estimate for completion of a damage assessment program describing an accelerated and modified ground-water monitoring program capable of determining:

(1) The extent and severity of ground-water contamination by hazardous waste constituents caused by the facility; and

(2) The extent to which the facility has caused the ground water in a USDW to exceed the maximum levels for the parameters specified in Appendix III.

(b) The owner/operator must prepare an outline of and time estimate for completion of a corrective action program describing applicable remedial measures to avoid contaminating ground water beyond the facility property boundary, such as limiting operations, adjusting the ground-water table gradient, and treating in-situ or removing the contaminated ground water.

Comment: The outlines of the facility's ground-water damage assessment and corrective action programs must be submitted to the Regional Administrator with Part B of the permit application under Part 122, Subparts A and B.

(c) The owner/operator must evaluate the results of the analyses required by §264.92(d)(2) as follows:

(1) The calculated arithmetic mean and variance for each indicator parameter specified in §264.92(b)(3) from each upgradient monitoring well is to be individually compared to the initial background arithmetic mean and variance of each indicator parameter, established in accordance with §264.92(c)(2), using the Student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and, in the case of pH, decreases also).

(2) The calculated arithmetic mean and variance for each indicator parameter specified in §264.92(b)(3) from each downgradient monitoring well is to be individually compared to the initial background arithmetic mean and variance of each indicator parameter, established in accordance with §264.92(c)(2), using the Student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and, in the case of pH, decreases also).

(d)(1) If the evaluations for the upgradient wells performed in accordance with paragraph (c)(1) above yield a significant increase (or pH decrease), the owner/operator must record and submit this information in accordance with §264.94.

(2) Based on this information, the Regional Administrator may at his discretion require the facility owner/operator to conduct additional sampling and analyses, and revise the facility's background datum.

(e) If the evaluations for downgradient wells performed in accordance with paragraph (c)(2) above yield a significant increase (or pH decrease), the facility will be suspected of affecting ground-water quality and the owner/operator must:

(1) Immediately obtain additional ground-water samples from those downgradient wells where a significant difference was detected, split the samples in two, and obtain additional analysis of all samples to determine whether the significant difference was a result of laboratory error.

(2) If the analyses of the split samples confirm the significant increase (or pH decrease), notify, in

writing, within seven days the Regional Administrator, and appropriate State and local officials, that the facility may be affecting ground-water quality.

(3) Within 15 days of notification, submit to the Regional Administrator for review and approval:

(i) A plan for conducting the damage assessment program, based on the outline prepared previously in accordance with paragraph (a), specifying the number of wells, their locations and depths, and the sampling, analysis, and evaluation procedures to be used to detect and quantify any hazardous waste constituents which may have been discharged from the facility into ground water. The damage assessment plan must be developed in consideration of and specifically related to the hydrogeology of the underlying aquifer; and

(ii) Any ground-water quality information, such as that discussed in paragraph (d), which could demonstrate that the facility is not affecting ground-water quality and that a damage assessment is unnecessary.

(f)(1) When instructed by the Regional Administrator, the owner/operator must immediately initiate his approved damage assessment program. Within 15 days of completion of the program, the owner/operator must submit to the Regional Administrator and to those State and local officials previously notified in accordance with paragraph (e) above, a written report containing the results of the damage assessment and a detailed description of recommended remedial measures based on the outline of the corrective action program prepared previously under paragraph (b).

(2) Based upon information included in the damage assessment report, the Regional Administrator may instruct the owner/operator to implement his corrective action program, as approved or modified by the Regional Administrator.

Comment: Based upon information included in the damage assessment report, the Regional Administrator may also:

(1) arrange for downgradient ground-water users to be notified;

(2) revoke or revise the facility owner's/operator's permit until the owner/operator has demonstrated that the corrective action program has been successful; and/or

(3) take other appropriate action.

(g) At least annually, the facility owner/operator must evaluate the ground-water surface elevation data obtained under §264.92(a) to determine whether the downgradient monitoring well location requirement under §264.91(a)(2) continues to be satisfied. If the evaluation shows that §264.91(a)(2) is no longer satisfied, the owner/operator must immediately modify the number, location, and/or depth of the monitoring wells to bring the ground-water monitoring system into compliance with this requirement.

264.94 Recordkeeeping and Reporting

(a) The facility owner/operator must maintain records of the analyses of samples from all ground-water monitoring wells required in §264.92(c) and (d), the associated ground-water surface elevations required in §264.92(e), and the evaluations required in §264.93, throughout the active life of the facility, and for disposal facilities throughout the post-closure care period.

(b) The facility owner/operator must report ground-water monitoring information as follows:

(1) Concentrations of the parameters listed in §264.92(b)(1) for each ground-water monitoring well must be submitted to the Regional Administrator within 15 days of the completion of each quarterly analysis during the first year when initial background concentrations are being established for the facility. The owner/operator must separately identify for each monitoring well any parameter whose concentration has been found to exceed the maximum contaminant levels listed in Appendix III.

(2) Concentrations of, and the required evaluations under §264.93(c) for, the parameters listed in §264.92(b)(3) for each ground-water monitoring well must be submitted to the Regional Administrator annually. The owner/operator must separately identify, in accordance with §264.93(d), any significant differences from background found in the upgradient wells. During the active life of the facility, this information must be

submitted as part of the annual report required under §264.75.

(3) Results of the evaluation of ground-water surface elevation under §264.93(g), and a description of the response to that evaluation, where applicable, must be submitted to the Regional Administrator as part of the annual report required under §264.75.

264.95 - 264.109 [Reserved]

SUBPART G - CLOSURE AND POST-CLOSURE

264.110 Applicability

Except as provided otherwise in §264.1:

(a) The regulations in this Subpart concerning closure apply to the owners/operators of all hazardous waste management facilities; and

(b) The regulations in this Subpart concerning post-closure apply to the owners/operators of all disposal facilities, i.e., to those facilities at which wastes will remain after final closure.

264.111 Closure Performance Standard

All facilities must be closed in a manner that minimizes: (1) any discharge of wastes, leachate, contaminated rainfall, or waste decomposition products to ground or surface waters or the atmosphere, and (2) the need for further maintenance to protect human health and the environment.

264.112 Closure Plan; Amendment of Plan

(a) The owner/operator of a facility must submit a closure plan to the Regional Administrator; for new facilities, the plan must be submitted prior to beginning treatment, storage, and/or disposal operations. The plan must identify the steps necessary to completely close the facility at any point during its expected life, as well as the steps necessary to close at the end of the expected life of the facility. The closure plan must include, but need not be limited to, the following:

(1) A description of how and when the facility will be partially closed, if applicable, and ultimately closed, including an identification of the maximum extent of the operation which will be unclosed during the life of the facility;

(2) The maximum inventory of wastes in storage and/or in treatment that is expected during the life of the facility;

(3) A description of the steps necessary to decontaminate facility equipment during closure; and

(4) A schedule for final closure which must include, as a minimum, the anticipated date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completion of treatment or disposal of waste inventory must be included, as must the planned date for removal of any residual wastes from storage facilities and treatment processes.)

Comment: The closure plan must be submitted to the Regional Administrator with Part B of the application for a permit under Part 122, Subparts A and B. This plan will be modified and/or approved by the Regional Administrator during the permitting process and incorporated into the conditions of the permit.

(b) During the active life of the facility, i.e., that period during which wastes are periodically received, the owner/operator may at any time submit an amended closure plan to the Regional Administrator for approval.

Comment: Part 122, Subpart B, requires that an owner/operator must submit an up-to-date closure plan to the Regional Administrator any time the Agency formally reviews a permit, including those times when a permit modification is sought.

264.113 Time Allowed for Closure

(a) Within 90 days of receiving the final volume of wastes, the owner/operator must treat and/or remove all wastes in storage or in process from the site, or dispose of them onsite, in accordance with the closure plan.

(b) Closure activities must be completed in accordance with the approved closure plan and within six months of receiving the final volume of wastes. The Regional Administrator may accept a longer closure period if the owner/operator can demonstrate that the required or planned closure activities, will, of necessity, take longer than six months to complete and that all steps have been taken to eliminate any substantial threat to human health and the environment from the unclosed but inactive facility.

264.114 Disposal or Decontamination of Equipment

When closure is completed, all facility equipment must have been properly disposed of or decontaminated by removal of all hazardous waste and residues.

264.115 Notification and Certification of Closure

(a) An owner/operator of a facility must notify the Regional Administrator in writing of the date he expects to complete closure at least 180 days before the end of final closure.

(b) When closure is completed, the owner/operator must submit to the Regional Administrator certification by the owner/operator and certification by a registered professional engineer that the facility has been closed in accordance with the specifications in the closure plan.

264.116 [Reserved]

264.117 Post-Closure Care and Use of Property; Period of Care

(a) Post-closure care must consist of at least the following:

  (1) Monitoring and reporting in accordance with the requirements of Subpart F; and

  (2) Maintenance of monitoring systems specified in §264.91.

(b) The Regional Administrator may require maintenance of any or all of the security requirements of §264.14 during the post closure period when:

  (1) Wastes remain exposed after completion of closure, or

  (2) Casual access by the public may pose a hazard to human health.

(c) Post-closure use of property on or in which hazardous waste remains after closure must in perpetuity be conducted in a manner that prevents disturbing the integrity of the final cover, liner(s), and any other components of the containment system, and the monitoring systems of the facility, unless the owner/operator can demonstrate to the Regional Administrator that the disturbance:

(1) Is necessary to the proposed use of the property, and will not result in an increase in the potential hazard to human health or the potential for environmental contamination, or

(2) Is necessary to reduce environmental contamination or a threat to human health.

(d) An owner/operator of a disposal facility must provide post-closure care for at least 30 years from the date of the completion of closure. However, the owner or operator may petition the Regional Administrator to allow some or all of the requirements for post-closure care to be discontinued or altered before the end of the 30-year period. The petition must include evidence demonstrating the secure nature of the facility that makes continuing the specified post-closure requirement(s) unnecessary--e.g., no detected leaks and none likely to occur, characteristics of the waste, application of advanced technology, or alternative disposal, treatment, or reuse techniques. At the end of the post-closure period, the Regional Administrator, if he finds that the continued integrity of the site or prior non-compliance with any applicable standards and requirements justifies it, may require the owner/operator to continue one or more of the post-closure care and maintenance requirements contained in the facility's post-closure plan, for a specified period of time. At the end of the specified period of time, the Regional Administrator will make the determination whether to continue or terminate post-closure care and maintenance at the facility. Anyone (a member of the public as well as the owner/operator) may petition the Regional Administrator for an extension or reduction of the post-closure care period based on cause. These petitions will be considered by the Regional Administrator when a new permit is issued, at closure, and at five-year intervals after the completion of closure.

264.118 Post-Closure Plan; Amendment of Plan

(a) The owner/operator of a disposal facility must submit a post-closure plan to the Regional Administrator; for new facilities, the plan must be submitted prior to beginning treatment, storage, and/or disposal operations. The plan must identify the activities which will be carried on after final closure and the frequency of those activities. The post-closure plan must include, but need not be limited to, the following:

(1) Monitoring activities and frequencies as specified in Subpart F for the post-closure period; and

(2) Maintenance activities and frequencies for monitoring equipment specified in §261.91 and for any security equipment specified by the Regional Administrator in §261.117(b).

Comment: The post-closure plan must be submitted to the Regional Administrator with Part B of the application for a permit under Part 122, Subparts A and B. This plan will be modified and/or approved by the Regional Administrator during the permitting process and incorporated into the conditions of the permit.

(b) At any time during the active life of the facility or during the post-closure care period, the owner/operator may submit an amended post-closure plan to the Regional Administrator for approval.

Comment: Additionally, an up-to-date post-closure plan must be submitted to the Regional Administrator any time the Agency formally reviews a permit, including those times when a permit modification is sought.

264.119 Notice to Local Land Authority

Within 90 days after closure is completed, the owner/operator of a disposal facility must submit to the local land authority and the Regional Administrator a survey plan indicating the location and dimensions of landfill cells, trenches, or other disposal areas, with respect to permanently surveyed benchmarks. This plan must be prepared and certified by a registered professional land surveyor. The plan filed with the local land authority must contain a note, prominently displayed, advising of the owner's/operator's obligation to restrict disturbance of the site as specified in §264.117(c). Additionally, the owner/operator must submit to the Regional Administrator and local land authority a record of the type, location, and quantity of hazardous wastes disposed of within each cell, trench, or area of the facility.

264.120 Notice in Deed to Property

The owner of the property on which a disposal facility is located must record a notation on the deed to the property or, in accordance with State law, on any other such instrument which is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous waste, and of the use restriction of §264.117(c).

> Comment: When applying for a permit under Part 122, Subparts A and B, an owner/operator of a disposal facility must submit evidence of compliance with this section.

SUBPARTS H, I, J, K, L, M, N, AND O [Reserved]

264.121 - 264.999 [Reserved]

APPENDIX I

RECORDKEEPING INSTRUCTIONS

The recordkeeping provisions of §265.73 specify that an owner/ operator of a facility must keep an operating record. This appendix provides additional instructions as to the manner in which portions of the operating record are to be kept. See §265.73(b) for additional recordkeeping requirements.

The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility in the following manner:

> Records of each hazardous waste received, treated, stored, or disposed of at the facility, which include the following:
>
> (1) If the waste is listed in §261.--, a description by its EPA hazardous waste list number. If the waste is not listed in §261.--, a description by its EPA hazardous waste characteristic(s) number as defined in §261.--, its common name, and the process that produced it (for example, filter cake from production of ----).
>
> Each hazardous waste listed in §261.--, and each hazardous waste characteristic or combination of characteristics defined in §261.--, has a unique four-digit number assigned to it. This number must be used for recordkeeping and reporting purposes.
>
> The waste description must also include the waste's physical form, i.e., liquid, sludge, solid, or contained gas.
>
> (2) The estimated or manifest-reported weight, or volume and density, where applicable, in one of the units of measure specified in Table 1; and
>
> (3) The method(s) (by handling code(s) as specified in Table 2) and date(s) of treatment, storage, and/or disposal.

TABLE 1

Unit of Measure	Symbol*	Density
Pounds	P	--
Short Tons	T	--
Gallons	G	P/G
Cubic Yards	Y	T/Y
Kilograms	K	--
Tonnes	M	--
Liters	L	K/L
Cubic Meters	C	M/C

*Single digit symbols are used here for data processing purposes.

TABLE 2

HANDLING CODES FOR TREATMENT, STORAGE, AND DISPOSAL METHODS

Enter the handling code(s) listed below that most closely represents the technique(s) used at the facility to treat, store, or dispose of each quantity of hazardous waste received.

1. Storage

S01	Container (barrel, drum, etc.)
S02	Tank
S03	Waste pile
S04	Surface impoundment
S05	Other (specify)

2. Treatment

(a) Thermal Treatment

T06	Pyrolysis
T07	Rotary kiln incinerator
T08	Fluidized bed incinerator
T09	Cement kiln incinerator
T010	Multiple hearth incinerator
T011	Electrical utility boiler
T012	Liquid injection incinerator
T013	Sludge incinerator
T014	Chemical waste incinerator
T015	Process heater
T016	Lime kiln
T017	Wood waste incinerator
T018	Other (specify)

(b) Chemical Treatment

T19	Cyanide destruction
T20	Chemical oxidation
T21	Chemical precipitation
T22	Chemical reduction
T23	Neutralization
T24	Degradation
T25	Chlorination
T26	Chemical fixation
T27	Detoxification
T28	Absorption mound
T29	Absorption field

T30	Ion exchange
T31	Other (specify)

(c) Physical Treatment

(1) Separation of Components

T32	Centrifugation
T33	Clarification
T34	Filtration
T35	Flocculation
T36	Sedimentation
T37	Decanting
T38	Coagulation
T39	Flotation
T40	Foaming
T41	Thickening
T42	Encapsulation
T43	Surface impoundment
T44	Holding tank
T45	Other (specify)

(2) Removal of Specific Components

T45	Blending
T47	Catalysis
T48	Distillation
T49	Evaporation
T50	Solvent Recovery
T51	Stripping
T52	Absorption - molecular sieve (activated carbon)
T53	Crystallization
T54	Sand filter
T55	Dialysis
T56	Electrodialysis
T57	Leaching
T58	Reverse osmosis
T59	Other (specify)

(d) Biological Treatment

T60	Land treatment
T61	Activated sludge
T62	Aerobic lagoon
T63	Anaerobic lagoon
T64	Spray irrigation
T65	Thickening filter
T66	Waste stabilization pond
T67	Septic tank

T68 Aerobic tank
T69 Other (specify)

3. Disposal

D70 Chemical waste landfill
D71 Land treatment (to be closed as a landfill)
D72 Surface impoundment (to be closed as a landfill)
D73 Ocean disposal
D74 Deep well injection
D75 Other (specify)

Appendix II

EPA Report Form
and
Instructions

Please print or type. Form designed for elite type (12 characters/inch). Form Approved OMB No. -R00XX

EPA U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE ANNUAL REPORT

(Collected under the authority of Section 3002 of RCRA.)

I. IDENTIFICATION NUMBER S F | | | | | | | | | | | | C I

OFFICIAL USE ONLY *(date received & reviewer)*

REVIEWER'S NAME

II. NAME OF BUSINESS

III. BUSINESS REPRESENTATIVE

A. NAME

B. TELEPHONE NUMBER *(area code & no.)*

IV. BUSINESS ADDRESS *(street or route no., city, & zip code)*

V. TYPE OF REPORT

☐ A. GENERATOR
☐ B. FACILITY
☐ C. UNMANIFESTED

VI. CLOSING DATE *(list yr.)*

VII. WASTE INFORMATION *(continue on reverse if necessary)*

IDENTIFIER	A. IDENTIFICATION NUMBER	B. INTERNATIONAL SHIPMENT *(mark 'X')*	C. WASTE DESCRIPTION 1. DOT HAZARD CLASS *(mark 'X')* a. COMBUSTIBLE	b. CORROSIVE	c. ETIOLOGIC AGENT	d. EXPLOSIVE A	e. EXPLOSIVE B	f. FLAMMABLE GAS	g. FLAMMABLE LIQUID	h. FLAMMABLE SOLID	i. IRRITATING AGENT	j. NON-FLAMMABLE GAS	k. ORGANIC PEROXIDE	l. ORM-E	m. OXIDIZER	n. POISON A	o. POISON B	p. RADIOACTIVE	2. EPA ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) *(see instructions)*	D. AMOUNT OF WASTE	E. UNIT OF MEASURE *(enter code)*	F. DENSITY *(enter number)*	G. HANDLING CODE *(enter code(s))*
1	2 13	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33 36 37 40 41 44 45 48	49 57	58	60 62	63 65 66 68 69 71 72 74 75 77 78 80
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							

59

I.D. NO.

Continued From Front

VII. WASTE INFORMATION *(continued from front)*

	A.	B.	C. WASTE DESCRIPTION																	D.	E.	F.	G.
			1. DOT HAZARD CLASS *(mark 'X')*														2. EPA						
IDENTIFIER	IDENTIFICATION NUMBER	INTERNATIONAL SHIPMENT *(mark 'X')*	COMBUSTIBLE	CORROSIVE	ETIOLOGIC AGENT	EXPLOSIVE A	EXPLOSIVE B	FLAMMABLE GAS	FLAMMABLE LIQUID	FLAMMABLE SOLID	IRRITATING AGENT	NON-FLAMMABLE GAS	ORGANIC PEROXIDE	ORM	OXIDIZER	POISON A	POISON B	RADIOACTIVE	ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) *(see instructions)*	AMOUNT OF WASTE	UNIT OF MEASURE *(enter code)*	DENSITY *(enter number)*	HANDLING CODE *(enter code(s))*
12																							
13																							
14																							
15																							
16																							
17																							

VIII. COMMENTS

IX. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the informati·n submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

60

SIGNATURE

DETAILED INSTRUCTIONS: HAZARDOUS WASTE MANAGEMENT REPORT

This report must be completed annually by all hazardous waste treatment, storage, and disposal facilities in compliance with hazardous waste regulations (40 CFR Part 264) under the authority of the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901).

Part I

Item I. Facility ID Number

The facility identification number requested here for private, municipal, and State-owned facilities is the Data Universal Numbering System, or otherwise called the DUNS Number, developed by Dunn and Bradstreet, Inc. Most business establishments in the United States have already been assigned DUNS numbers, including all types and sizes of business establishments, branches, factories, distribution centers, and purchasing units. State and municipal facilities, including publicly owned treatment works, have also been assigned DUNS numbers.

All facilities engaged in the generation, transport, and treatment, storage, and disposal of hazardous waste will be assigned a facility identification number under the authority of Section 3010 of RCRA as part of the Hazardous Waste Facility Notification program.

If you need to find out the DUNS number for your business, you can obtain this information tree of charge by calling the nearest office of Dunn and Bradstreet, Inc.

For Federal facilities, the General Services Administration (GSA) real property number should be used. All Federal facilities have already been assigned a real property number by GSA. If you don't know your number, call the nearest local office of GSA.

Fill in the number as follows:

- STATE CODE - In the first two positions of the number insert the U.S. Postal Service State Code for the appropriate State or territory in which the facility is located, such as PA, MD, NJ, NY, OR MA;
- DUNS OR GSA Identifier and Number - In the remaining positions after the State code insert a "D" for a private, municipal, or State-owned facility followed by the nine-digit DUNS number; OR insert a "G" for a Federally-owned facility followed by the GSA number.

EXAMPLES

1. Private facility __________ PAD784621382 in Pennsylvania.
2. Federal facility __________ NYG284370155 in New York.
3. State facility __________ CAD362429824 in California.

Item II: RCRA Permit Number

Give the number of the presently effective RCRA permit issued to the facility, or if you have previously filed an application but have not yet received a permit, give the number of the application, if any.

Item III: Reporting Period

Enter the calendar year or the closing date of the period for which the report is made.

Item IV: Name of Facility

The facility is the distinct activity or installation, under the responsibility of the owner or operator, legally required to complete and submit this report.

Name the facility as it is officially or legally referred to in order to distinguish it from similar entities in the same geographical area. Do not use colloquial names as a substitute for the official name.

Item V: Facility Contact

Give the name, title, and work telephone number of a person who is thoroughly familiar with the operation of the facility and with the facts reported and who can be contacted by reviewing offices if necessary.

Item VI: Facility Mailing Address

Give the complete mailing address of the facility's main office, where correspondence should be sent. This often will not be the same address used to designate the location of the facility or activity.

Item VII: Facility Location

Give the location of the facility identified in Item IV of this form.

Items VIII-IX: [Reserved]

Item X: Owner Information

Under Item X-A, enter the name, as it is legally referred to, of the person, firm, public organization, or any other entity which owns or is directly responsible for hazardous waste activity described in this report. This may or may not be the same as the facility or activity producing the waste. Do not use colloquial names as a substitute for the official name.

Under item X-B enter the appropriate letter to indicate the type of ownership. Indicate "public" for a facility solely owned by local government(s) such as a city, town, county, parish, etc.

Under items C, D, E, F, and G, enter the telephone number and address of the owner identified in item X-A.

Item XI: Comments [Reserved]

Item XII: Certification

Federal statutes provide for severe penalties for submitting false information on this. 18 U.S.C. Section 1001 provides that "Whoever, in any matter within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals or covers up by any trick, scheme, or device a material fact, or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both."

In addition, Section 3008(d) of the Resource Conservation and Recovery Act provides for a fine up to $25,000 or imprisonment up to one year for a first conviction for making a false statement in any report under the Act, and for double these penalties upon subsequent convictions.

The facility owner/operator, or his authorized representative, must sign and date the certification.

PART II

Item I: Facility I.D. Number

Enter the facility identification number as described under Item I of Part I on each attached form.

Item II: Numbering of Attachments

The responsible official certifying Part I shall initial each attached form. Each attached sheet must be numbered as the second of two, the second, and the third of three, and so on, so all sheets are sequentially identified.

Item III: Reporting Period

Enter the calendar year or the closing date of the period for which the report is made.

Item IV: Waste Information

IV-A: Waste Source

Enter the generator of record for the described waste by the identification number and the facility legal name. Enter the identification number in the first 12 spaces as described under Item I Part I instructions. Enter the facility legal name in the remaining spaces.

If more than one waste from the same generator is listed, enter only the facility identification number for each waste after the first, under waste source.

For international shipments, enter the name, address, and country of origin of the generator, or the name and address of the importer of record.

For unmanifested wastes, enter the identification number, the legal name of the generator, and the identification number and name of the transporter, if known.

For wastes generated and treated, stored or disposed at the site of generation, enter the generator identification number.

IV-B:

Enter a description of each waste corresponding to the generator or source entered in column IV-A.

Describe each waste or aggregated waste stream managed at your facility during the reporting period by a name using the specific manufacturing or other process generating the waste; the common name of the waste; and the exact chemical or generic chemical name of the waste, if known.

For wastes that are listed under the RCRA waste regulations (40 CFR 261.14), enter the listed name, abbreviated if necessary, and the EPA waste code. (See IV-C below.)

IV-C:

Enter the four-digit EPA hazardous waste list number for listed waste, or for the major component of a mixture of more than one listed waste.

For unlisted wastes, enter the four-digit EPA hazardous waste characteristic(s) number. (See §261.--.)

IV-D:

Enter an EPA handling code for each waste. Where more than one EPA handling code would apply, report only the code representing the current status or final disposition of the waste at your facility. Handling codes are given in Table 2 of Appendix I.

IV-E: Waste Amount

Enter the waste amount, converted to metric tons, for each waste.

APPENDIX III

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

Parameter	Maximum Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Flouride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2, 4-D	0.1
2, 4, 5-TP Silvex	0.01
Radium	5 pCi/l
Gross Alpha	15 pCi/l
Gross Beta	4 millirem/yr
Turbidity	1/TU
Coliform Bacteria	1/100 ml

APPENDIX IV

Tests for Significance

As provided in §264.93(c), the owner/operator must use the Student's t-test for determination of statistically significant differences in ground-water monitoring data. For three of the ground-water monitoring indicator parameters (total organic carbon, total organic halogen, and specific conductance) a single tailed Student's t-test must be used to test for significant differences at the 0.01 level for increases over background. The difference test for pH must be a two-tailed Student's t-test at the 0.01 level of significance.

The number of replicate measurements (i.e., number of times measurements will be made on a single sample of well water) to be made on each sample must be determined separately for each indicator. The number of replicate measurements must, at a minimum, provide for a 95 percent confidence interval with relative precision (i.e., the interval length expressed as a percentage of the sample mean) equal to or less than 10 percent. The minimum number of replicates required may be different for different parameters and measurement techniques as a result of variability of individual measurement techniques, both procedures and equipment.

Specification of a 95 percent confidence interval, precision equal to or less than 10 percent, and testing at the 0.01 significance level, are included to minimize the possibility of not detecting significant differences.

Methods for determining the minimum number of replicates (sample size) for various specifications can be found in most introductory statistics texts (such as Dixon, W.J. and F.J. Massey, 1969. "Introduction to Statistical Analyses." McGraw-Hill, New York, pp. 270-273).

Part 265 - INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

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SUBPART A - GENERAL

265.1 Purpose, Scope, and Applicability

(a) The purpose of this Part is to establish minimum national standards which define the acceptable management of hazardous waste during the period of interim status. These standards apply to owners and operators of facilities which treat, store, and dispose of hazardous waste who have fully complied with the requirements for interim status under Section 3005(e) of RCRA and the regulations under 40 CFR Part 122.23(a), but who have not had final administrative disposition of their permit application made. These standards apply to all activities affecting any hazardous waste handled at such facilities after the effective date of these regulations.

Comment: As stated in Section 3005(a) of RCRA, upon and after the effective date of regulations under that Section, i.e., 40 CFR Part 122 regulations, the treatment, storage, and disposal of hazardous waste is prohibited except in accordance with a permit. Section 3005(e) provides for the continued operation of an existing facility which meets certain conditions until final administrative disposition of the owner's/operator's permit application is made.

(b) The requirements of this Part do not apply to the following:

(1) Disposing of hazardous waste by means of underground injection, under Safe Drinking Water Act (SDWA) regulations (except that these Part 265 regulations do apply to the aboveground treatment and/or storage of hazardous waste before it is injected underground);

(2) Disposing of hazardous waste by means of ocean disposal under Marine Protection, Research, and Sanctuaries Act (MPRSA) regulations (except that these Part 265 regulations do apply to the treatment and/or storage of hazardous waste before it is loaded onto an ocean vessel to be incinerated or disposed at sea); and

(3) Treating, storing, and/or disposing of any of the wastes specified in §261.4.

(c) An owner/operator of a publicly owned treatment works (POTW) that receives hazardous waste by truck or rail is exempt from all requirements of this Part, except the requirements of §§265.71, 265.72, 265.75, and 265.76.

265.2 - 265.9 [Reserved]

SUBPART B - GENERAL FACILITY STANDARDS

265.10 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §265.1.

265.11 Identification Number

Every facility owner/operator must apply to EPA for an identification number in accordance with the EPA notification procedures (--FR------), except as provided otherwise in §265.1(b).

265.12 Required Notices

(a) An owner/operator of a facility that has arranged to receive hazardous waste from foreign sources must notify the Regional Administrator in writing at least two weeks in advance of the expected date of arrival of these shipments at the facility.

(b) Before transferring ownership or operation of a facility during its operating life, or a disposal facility during the post-closure care period, the owner or operator must notify the new owner or operator in writing of the requirements of this Part. (Also see §265.150.)

265.13 General Waste Analysis

(a)(1) Before an owner/operator manages any hazardous waste, he must obtain a detailed chemical and physical analysis of the waste. At a minimum, this analysis must contain all the information which must be known in order to treat, store, or dispose of the waste in accordance with the requirements of this Part.

(2) The analysis may include data developed pursuant to Part 261, and existing data on the waste which is published or documented (e.g., the facility's records of analyses performed on the waste prior to the effective date of the regulations, or studies conducted

on waste generated from processes similar to that which generated the waste to be managed at the facility, etc.).

(3) The analysis must be conducted in accordance with, and repeated at the frequency specified in, the waste analysis plan required in paragraph (b) below. At a minimum, the analysis must be repeated when the owner/operator is notified, or has reason to believe, that the process or operation generating the waste has changed, and, for off-site facilities, when the results of the tests required in paragraph (a)(4) below indicate that the composition or the characteristics of the waste received at the facility do not match the waste designated on the accompanying manifest.

(4) For off-site facilities, owners/operators must determine whether the waste shipments received at the facility match the identity of the waste specified on the accompanying manifest.

Comment: The owner/operator of an off-site facility may make an arrangement with the generator of the waste to supply part of the required information. If the generator does not supply the information, and the owner/operator chooses to accept a waste, he is responsible for obtaining the information required to comply with this section.

(b) Owners/operators must develop a waste analysis plan which describes the procedures which the owner/operator will carry out to comply with paragraph (a). At a minimum, the plan must specify the following:

(1) The parameters for which each waste will be analyzed and the rationale for the selection of these parameters (i.e., how analysis for these parameters will provide sufficient information on the waste's properties to comply with paragraph (a));

(2) The test methods which will be used to test for these parameters;

(3) The sampling methodology which will be used to obtain a representative sample of the waste to be analyzed (see Appendix I of Part 261 for EPA-approved sampling methods);

(4) The frequency at which the initial analysis of the waste will be reviewed and/or repeated to ensure that the analysis is accurate and up to date;

(5) For off-site facilities, the waste analyses that waste generators have agreed to supply; and

(6) Where applicable, the methods which will be used to meet the additional waste analysis requirements for specific waste management methods as specified in §§265.193, 165.225, 265.252, 265.273, 265.303, and 265.345.

(c) For off-site facilities, the waste analysis plan required in paragraph (b) must also specify the procedures which will be implemented to ensure that the shipments of waste received at the facility match the identity of the waste designated on the accompanying manifest. At a minimum, the plan must describe the following:

(1) The tests which will be used to determine the identity of each shipment of waste managed at the facility; and

(2) The sampling methodology which will be used to obtain a representative sample of the waste to be identified.

265.14 Security

(a) A facility owner/operator must prevent the unknowing entry, and minimize the possibility of the unauthorized entry, of persons or livestock onto the active portion of his facility, *unless*:

(1) Physical contact with the waste, structures, or equipment within the active portion of the facility will not injure unknowing and/or unauthorized persons or livestock which may enter the active portion of a facility, and

(2) Disturbance of the waste or equipment, by the unknowing and/or unauthorized entry of persons or livestock onto the active portion of a facility, will not endanger human health or the environment.

(b) To ensure compliance with paragraph (a), facilities must have:

(1) A 24-hour surveillance system (e.g., television monitoring of the active portion and/or surveillance of the active portion by guards or facility personnel) which continuously monitors and controls entry onto the active portion of the facility; or

(2) (i) An artificial and/or natural barrier (e.g., a fence in good repair and/or a cliff), which completely surrounds the active portion of the facility; and

(ii) A means to control entry through the gates or other entrances to the active portion of the facility (e.g., an attendant, television monitors, locked entrance, controlled roadway access to the facility) both during the facility's operating hours and when the facility is unattended.

The requirements of paragraph (b) are satisfied if the facility or plant within which the active portion is located itself has a surveillance system or a barrier and a means to control entry which complies with the requirements of paragraph (b)(1) or (2).

(c) To ensure compliance with paragraph (a), a sign with the following legend, "Warning - Unauthorized Personnel Keep Out," must be posted at each entrance to the active portion of a facility and in sufficient numbers to be seen from any approach to the active portion of a facility. The legend must be written in English and in any other language predominant in the area surrounding the facility (e.g., facilities in counties bordering the Canadian province of Quebec must post signs in French; facilities in counties bordering Mexico must post signs in Spanish), and must be legible from a distance of at least twenty-five feet. Existing signs with a legend other than "Warning - Unauthorized Personnel Keep Out" may be used if the legend on the sign indicates that only authorized personnel are allowed to enter the active portion, and that entry onto the active portion is potentially dangerous.

Comment: Owners/operators are encouraged to also describe on the sign the type of hazard (e.g., hazardous waste, flammable waste, etc.) contained within the active portion of the facility.

Comment: See §265.117(b) for discussion of security requirements at disposal facilities during the post-closure care period.

265.15 General Inspection Requirements

(a) Facility owners/operators must inspect facilities for equipment malfunctions and deterioration, operator errors, and spills which may be causing or may lead to release of hazardous constituents to the environment or pose a threat to human health outside the facility. These inspections must be conducted frequently enough to identify problems in time to take corrective action before they harm human health or the environment.

(b) Facility owners/operators must develop and implement a schedule for inspecting all monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment (such as dikes and sump pumps) that are important to preventing, detecting, or responding to environmental or human health hazards. The schedule must identify the types of problems (i.e., malfunctions or deterioration) which are to be looked for during the inspection (for example, inoperative sump pump, leaking fitting, eroding dike, etc.). The frequency of inspection may vary for the items on the schedule, but should be based on the owner's/operator's perception of the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when in use. At a minimum, the inspection schedule must include the items and frequencies called for in §§265.174, 265.194, 265.226, and 265.347.

(c) The owner/operator must make any repairs, or take other remedial action, on a time schedule which ensures that any deterioration or malfunction discovered does not lead to an environmental or human health hazard. Where an incident is imminent or has already occurred, remedial action must be taken immediately.

(d) The owner/operator must keep records of inspections in an inspection log or summary. These records must be retained for at least three years. At a minimum, these records must include the date and time of the inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs made or remedial actions taken.

265.16 Personnel Training

(a)(1) Facility personnel must successfully complete a program of instruction and/or on-the-job training that teaches them to perform their duties in a way that ensures the facility's compliance with the requirements of this Part and that includes all the elements described in paragraph (a)(3) below.

(2) This program must be directed by a person trained in hazardous waste management procedures, and must include instruction, supplementing the facility personnel's existing job knowledge, which teaches facility personnel hazardous waste management procedures (including contingency plan implementation) relevant to the positions in which they are employed.

(3) At a minimum, the training program must be designed to ensure that facility personnel are able to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency systems, including, but not necessarily limited to, the following, where applicable:

(i) Procedures for inspection, repair, and replacement of facility emergency and monitoring equipment;

(ii) Key parameters for automatic waste feed cutoff systems;

(iii) Communications and/or alarm systems;

(iv) Response to fires or explosions;

(v) Response to ground-water contamination incidents; and

(vi) Shutdown of operations.

(b) Facility personnel must successfully complete the program required in paragraph (a) within six months after the effective date of employment or assignment to a facility or a new position at a facility, whichever is later. New employees must not work in unsupervised positions until they have completed the training requirements of paragraph (a).

(c) Facility personnel must take part in an annual review of their initial training in both contingency procedures and the hazardous waste management procedures relevant to the positions in which they are employed.

(d) Owners/operators of facilities must maintain the following documents and records and make them available to the Regional Administrator upon request:

(1) The job title for each position at the facility related to hazardous waste management, and the name of the employee filling each job;

(2) A written job description for each position listed under paragraph (d)(1). This description may be consistent in its degree of specificity with descriptions for other similar positions in the same company location or bargaining unit, but must include the requisite skill, education, or other qualifications, and duties of facility personnel assigned to each position;

(3) A written description of the type and amount of both introductory and continuing training that will be given to each person filling a position listed under paragraph (d)(1);

(4) Records that document that the training or job experience required under paragraphs (a), (b), and (c) has been given to, and completed by, facility personnel.

(e) Training records on current personnel must be maintained until closure of the facility; training records on former personnel must be maintained for at least three years. Personnel training records may accompany personnel transferred within the same company.

265.17 - 265.29 [Reserved]

SUBPART C - PREPAREDNESS AND PREVENTION

265.30 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §265.1.

265.31 Maintenance and Operation of Facility

Facilities must be maintained and operated so that the possibility of a discharge, fire, or explosion which could threaten the environment or human health outside the facility is minimized.

265.32 Required Equipment

All facilities must be equipped with the following, unless there are no hazards at the facility which could require a particular kind of equipment specified below:

(a) An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility employees;

(b) A device capable of summoning external emergency assistance from local police departments, fire departments, or State or local emergency response teams, such as a telephone (immediately available at the scene of operations) or a hand-held two-way radio;

(c) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment, and decontamination equipment; and

(d) Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.

265.33 Testing and Maintenance of Equipment

All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.

265.34 Access to Communication or Alarm System

(a) Whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all employees involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless such a device is not required under §265.32 above.

(b) If there is ever just one employee on the premises while the facility is operating, he must have immediate access to a device capable of summoning external emergency assistance, such as a telephone (immediately available at the scene of operation), or a hand-held two-way radio, unless such a device is not required under §265.32 above.

265.35 Required Aisle Space

The facility owner/operator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.

265.36 Special Handling for Ignitable or Reactive Waste

The facility owner/operator must take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. This waste must be separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), spontaneous ignition (e.g., from heat-producing chemical reactions), and radiant heat. While ignitable or reactive waste is being handled, the facility owner/operator must confine smoking and open flame to specially designated locations. "No Smoking" signs must be conspicuously posted wherever there is normally a hazard from ignitable or reactive waste.

265.37 Arrangements with Local Authorities

[Analogue to §265.52(b) to be added here]

265.38 - 265.49 [Reserved]

SUBPART D - CONTINGENCY PLAN AND EMERGENCY PROCEDURES

265.50 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as provided otherwise in §265.1.

265.51 Purpose and Implementation of Contingency Plan

(a) The owner/operator must develop a contingency plan for each facility designed to minimize human health and environmental damage in the event of an unplanned sudden or non-sudden discharge of hazardous waste to air, soil, or surface water.

(b) The provisions of the plan must be implemented immediately whenever there is a discharge of hazardous waste which could threaten the environment or human health outside the facility.

265.52 Content of Contingency Plan

(a) The plan must include provisions for controlling spills. If a facility owner/operator already has prepared a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with 40 CFR 112 and/or 40 CFR 151, or some other emergency or contingency plan, he need only amend that plan to incorporate hazardous waste management provisions sufficient to comply with the requirement of this Part.

(b) This plan must describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services, where these arrangements are appropriate for the type of waste handled at the facility or the potential need for the services of these organizations. Facility owners/operators must attempt to make the following arrangements, as appropriate, to the types of waste handled at their facility. Where State or local authorities decline to enter into such arrangements, the facility owner/operator must document the refusal in writing.

(1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to and roads inside the facility, and possible evacuation routes;

(2) In the event that more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority; and

(3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers.

(c) The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as facility emergency coordinator (see §265.55), and this list must be kept up to date. Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates.

(d) The plan must include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, alarms (internal and external), and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and physical description of each item on the list, and a brief outline of its capabilities.

(e) The plan must include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must outline signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by discharges of hazardous waste or fires).

265.53 Copies of Contingency Plan

A copy of the contingency plan and all revisions to the plan must be:

(a) Maintained at the facility;

(b) Made available to the Regional Administrator upon request; and

(c) Submitted to all local police departments, fire departments, hospitals, and State and local emergency response teams that may be called upon to provide emergency services.

265.54 Amendment of Contingency Plan

The contingency plan must be reviewed, and immediately amended, if necessary, under any of the following circumstances:

(a) Revisions to applicable regulations;

(b) Failure of the plan in an emergency;

(c) Changes in the facility design, construction, operation, maintenance or other circumstances that materially increase the potential for discharges of hazardous waste or changes the response necessary in an emergency;

(d) Changes in the list of emergency coordinators; or

(e) Changes in the list of emergency equipment.

265.55 Emergency Coordinator

Whenever the facility is in operation, there must be at least one employee either present or on call (i.e., available to respond even though not on the facility premises) with the responsibility for coordinating all emergency response measures. This facility emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of manifests within the facility, if applicable, and the facility layout. In addition, this person must have the authority to commit the resources needed to implement the contingency plan.

> Comment: The emergency coordinator's responsibilities are more fully spelled out in §265.56 below. Applicable responsibilities for the emergency coordinator vary, depending on factors such as type and variety of waste(s) handled by the facility, and type and complexity of the facility.

265.56 Emergency Procedures

(a) The facility's emergency coordinator (or his designee when the emergency coordinator is on call) must immediately:

(1) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel of any imminent of actual emergency situation; and

(2) Notify appropriate State or local agencies with designated response roles whenever their assistance is needed.

(b) In the event of a discharge, fire, or explosion, the facility's emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any discharged materials. He may do this by observation and/or review of facility records or manifests and, if necessary, by chemical analysis.

(c) The facility's emergency coordinator must immediately assess possible hazards to the environment and human health outside the facility that may result from a discharge, fire, or explosion. This assessment must consider both direct and indirect effects of the discharge, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water runoff from water or chemical agents used to control fire and heat-induced explosions).

(d) The facility's emergency coordinator must immediately report his assessment that the facility has had a discharge, fire, or explosion which could threaten the environment or human health outside the facility, as follows:

(1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to assist appropriate officials in making the decision whether local areas should be evacuated;

(2) He must immediately notify either the government official designated as the on-scene coordinator for that geographical area (in the applicable regional contingency plan under 40 CFR 1510), or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include:

(i) Name and telephone number of reporter;

(ii) Name and address of facility;

(iii) Time and type of incident (e.g., discharge, fire);

(iv) Name and quantity of material(s) involved, to the extent available; and

(v) The extent of injuries, if any.

(e) During an emergency, the facility's emergency coordinator must take all reasonable measures necessary to ensure that fires and explosions do not occur, recur, or spread to other hazardous waste at the facility. These measures must include, where applicable, stopping processes and operations, collecting and containing discharged waste, and removing or isolating containers.

(f) If the facility stops operations in response to a discharge, fire, or explosion, the facility's emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.

(g) Immediately after an emergency, the facility's emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a discharge, fire, or explosion at the facility. The recovered material must be handled as a hazardous waste unless it is analyzed and determined not to be, using the procedures specified in Part 261.__.

(h) The facility's emergency coordinator must ensure that, in the affected area(s) of the facility:

(1) No waste that may be incompatible with the released materials is treated, stored, or disposed of until cleanup procedures are completed; and

(2) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.

(i) The facility owner/operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with paragraph (h) before operations are resumed in the affected area(s) of the facility.

(j) The facility owner/operator must record the time, date, and nature of any emergency. Within 15 days after the emergency, he must submit a written report on the emergency to the Regional Administrator. The report must include:

(1) Name, address, and telephone number of the owner/operator;

(2) Name, address, and telephone number of the facility;

(3) Date, time, and type of incident (e.g., fire, discharge);

(4) Name and quantity of material(s) involved;

(5) The extent of injuries, if any;

(6) An assessment of possible hazards to the environment and human health outside the facility, where this is applicable; and

(7) Estimated quantity and disposition of recovered material that results from the incident.

265.56 - 265.69 [Reserved]

SUBPART E - MANIFEST SYSTEM, RECORDKEEPING, AND REPORTING

265.70 Applicability

The regulations in this Subpart apply to owners and operators of both on-site and off-site facilities, except as provided otherwise in §265.1; Sections 265.71, 265.72, and 265.76 do not apply to owners and operators of on-site facilities that do not receive any hazardous waste from off-site sources.

265.71 Use of Manifest System

An owner/operator, or his agent, of a facility that receives hazardous waste accompanied by a manifest must:

(a) Sign and date each copy of the manifest to certify that the movement covered by the manifest has been received.

(b) Where he discovers significant discrepancies in the movement (as defined in §265.72), note them in the comment section of each copy of the manifest (see §265.13(a) for waste analysis requirement).

(c) Immediately provide the transporter with at least one copy of the manifest.

(d) Within 30 days of the delivery, forward the manifest to the generator.

(e) Retain for at least three years a copy of each manifest with the certifications of the generator, transporter(s), and owner/operator of the facility, or their agents.

265.72 Manifest Discrepancies

(a) Manifest discrepancies are differences between the quantity and/or type of hazardous waste designated on the manifest, and the quantity and/or type of hazardous waste actually received. Significant discrepancies in quantity are variations greater than 10 percent of the shipment in weight; for batch shipments, zero variation. Significant discrepancies in type are obvious differences which can be discovered by inspection of waste analysis, such as waste solvent substituted for waste acid, or when someone includes toxic constituents not reported on the manifest.

(b) Upon discovery of a significant discrepancy in a manifest, the owner/operator must attempt to reconcile the discrepancy by telephone conversations with the waste generator and/or transporter(s), or by other means. If the discrepancy is not resolved within 15 days of receipt of the waste, the owner/operator must immediately submit a letter report, including a copy of the manifest at issue, to the Regional Administrator.

265.73 Operating Record

(a) An owner/operator of a facility must keep an operating record. This record must be open at all reasonable times for inspection by any duly authorized employee or agent of EPA.

(b) The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility.

(1) A description and the quantity of each hazardous waste received, and the method(s) and date(s) of its treatment, storage, and/or disposal at the facility (see Appendix I for further instructions);

(2) The location and quantity of each hazardous waste within the facility. For disposal facilities, the location and quantity of each hazardous waste must be recorded on a map or diagram of each cell, trench, or disposal area (see §§265.119 and 265.309). All the above information must include cross-references to

specific manifest document numbers, if the waste was accompanied by a manifest;

(3) Records and results of waste analyses and trial tests performed as specified in §§265.13, 265.193, 265.225, 265.252, 265.273, 265.303, and 265.345;

(4) Summary reports and records of all incidents that require implementing the contingency plan as specified in §265.56(j);

(5) Records and results of inspections as required by §265.15(d) (except these data need be kept only three years); and

(6) Monitoring data where required by §§265.90, 265.276, 265.278, and 265.280.

Comment: Monitoring data at disposal facilities also must be kept throughout the post-closure period. See §265.94(a).

265.74 Disposition of Records

Records of waste disposal locations required to be maintained under §265.73(b)(2) must be turned over to the Regional Administrator and local land authority upon closure of the facility (see §265.119).

265.75 Annual Report

Owners/operators of facilities that treat, store, or dispose of hazardous waste must prepare and submit a single copy of an annual report to the Regional Administrator by March 1 of each year. The annual report must cover facility activities during the previous calendar year and must include the following information (see Appendix II for the report form):

(a) The EPA identification number, name, and address of the facility;

(b) The calendar year covered by the report;

(c) For off-site facilities, the identification number of each hazardous waste generator from which a hazardous waste was received during the year; for international shipments, the name and address of the foreign generator must be given;

(d) A description and the quantity of each hazardous waste received by the facility during the year. For off-site facilities, this information must be listed by identification number of each generator;

(e) The method(s) of treatment, storage, or disposal for each hazardous waste;

(f) Monitoring data, where required under §265.94(b)(2) and (3); and

(g) A certification signed by the owner/operator of the facility or his authorized representative.

265.76 Unmanifested Waste Report

If a facility accepts for treatment, storage, or disposal any hazardous waste from off-site sources without an accompanying manifest (except for shipments that do not require a manifest because of the exclusions in §261.4), the owner/operator must prepare and submit a single copy of a report to the Regional Administrator within 15 days of the receipt of the waste. The report must include the following information, if available (see Appendix II for the report form):

(a) The EPA identification number, name, and address of the facility;

(b) The date of receipt of the waste;

(c) The word "unmanifested" under the comments section (or check appropriate box) of the report form;

(d) The identification number, name, and address of the generator, or else the transporter;

(e) A description and the quantity of each unmanifested hazardous waste received by the facility;

(f) The method(s) of treatment, storage, or disposal for each hazardous waste;

(g) A certification signed by the owner/operator of the facility or his authorized representative; and

(h) A brief explanation of why the shipment was unmanifested, in the comments section of the report form.

265.77 Additional Reports

In addition to the annual and unmanifested waste reporting requirements described in §§265.75 and 265.76, a facility owner/operator must also report to the Regional Administrator:

(a) Discharges, fires, and explosions as specified in §265.56(j);

(b) Ground-water contamination and monitoring data as specified in §§265.93 and 265.94;

(c) Before facility closure as specified in §265.115; and

(d) Upon his request, such information as the Regional Administrator may deem necessary to determine compliance with the requirements of this Part.

265.78 - 265.89 [Reserved]

SUBPART F - GROUND-WATER MONITORING

265.90 Applicability

(a) An owner/operator of a surface impoundment, landfill, or land treatment facility must, within one year of the effective date of these regulations, install, maintain, and operate a ground-water monitoring system as specified in this Subpart, and must comply with the sampling, analysis, recordkeeping, and reporting requirements of this Subpart. However, a lesser degree of ground-water monitoring (or no monitoring) may be acceptable if the owner/operator has available for submission, at any time the Regional Administrator so requests, a demonstration that there is a low (or no) potential for migration of hazardous waste constituents to an Underground Source of Drinking Water (USDW), to water supply wells, or to surface water via the uppermost aquifer, during the active facility life and post-closure care period. This demonstration must be certified by a qualified geologist or geotechnical engineer and must address the following:

(1) Whether or not the uppermost aquifer is a USDW and, if not, whether there is a potential for migration via the uppermost aquifer to a USDW or surface water;

(2) A thorough hydrogeologic investigation based on, but not limited to, evaluations of logs of test borings made by a geologist present during drilling, which establishes:

(i) Unsaturated zone characteristics (i.e., geologic materials, physical properties, and depth to ground water); and

(ii) Saturated zone characteristics (i.e., geologic materials, physical properties, and rate of ground-water flow);

(3) A water balance of precipitation, evapotranspiration, runoff, and infiltration; and

(4) Proximity to water supply wells and use of water.

(b) An owner/operator of a tank may be required by the Regional Administrator to comply with all or part of the ground-water monitoring requirements of this Subpart if the Regional Administrator determines that there is a high potential for discharge of hazardous waste constituents to ground water. The Regional Administrator will use the following criteria in making this determination:

(1) The ability of the owner/operator to detect leakage by visual inspection;

(2) The permeability of the underlying continuous base, if there is one; and

(3) The ability of the tank to contain the waste.

265.91 Ground-Water Monitoring System

(a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of:

(1) Enough monitoring wells (no less than one) located hydraulically upgradient from the limit of the waste management area and installed so as to yield ground-water samples that are:

(i) representative of uncontaminated, background ground-water quality; and

(ii) not contaminated by the facility; and

(2) Enough monitoring wells (no less than three) installed hydraulically downgradient at the limit of the waste management area so that their number, locations, and depths will ensure that any hazardous waste constituent will be detected upon migration from the waste management area.

(b) All monitoring wells must be cased to enable sample collection at depths where appropriate aquifer flow zones exist, and must be screened or perforated and packed with gravel or sand at these depths, where necessary. The annular space above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground water.

265.92 Sampling and Analysis

(a) The owner/operator must analyze samples from the installed ground-water monitoring system. Ground-water sampling and analysis procedures must be established and must include techniques for:

(1) Sample collection,

(2) Sample preservation and shipment,

(3) Analytical procedures, and

(4) Chain of custody control.

Comment: See "Procedures Manual For Ground-water Monitoring At Solid Waste Disposal Facilities," EPA-530/SW-611, August 1977, and "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1979 for discussions of appropriate sampling and analysis procedures.

(b) The owner/operator must determine the concentration of the following in ground-water samples in accordance with paragraphs (c) and (d):

(1) Parameters characterizing the suitability of the ground water as a drinking water supply, as specified in Appendix III.

(2) Parameters establishing ground-water quality:

(i) Chloride

(ii) Iron

(iii) Manganese

(iv) Phenols

(v) Sodium

(vi) Sulfate

Comment: These parameters are to be used as a basis for comparison in the event a damage assessment is required in §265.93(e).

(3) Parameters used as indicators of ground-water contamination:

(i) pH

(ii) Specific Conductance

(iii) Total Organic Carbon

(iv) Total Organic Halogen

(c)(1) Initial background concentrations of all parameters specified in paragraph (b) must be established for all monitoring wells quarterly for a period of one year.

(2) Establishment of initial background for the indicator parameters specified in paragraph (b)(3) must include, for each indicator parameter, determination of the arithmetic mean and variance of the analytic data, by

pooling the respective analytical data for samples obtained from upgradient wells.

(d) All monitoring wells must be sampled and the samples analyzed according to the following frequencies:

(1) Samples collected to indicate ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) at least annually.

(2) Samples collected to check for ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) at least semiannually.

(e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.

265.93 Preparation, Evaluation, and Response

(a) Within one year of the effective date of these regulations, the owner/operator must prepare an outline of and time estimate for completion of a damage assessment program describing an accelerated and modified ground-water monitoring program capable of determining:

(1) The extent and severity of ground-water contamination by hazardous waste constituents caused by the facility, and

(2) The extent to which the facility has caused the ground water in a USDW to exceed the maximum levels for the parameters specified in Appendix III.

(b) The owner/operator must evaluate the results of the analyses required by §265.92(d)(2) as follows:

(1) The calculated arithmetic mean and variance for each indicator parameter specified in §265.92(b)(3) from each upgradient monitoring well is to be individually compared to the initial background arithmetic mean and variance of each indicator parameter, established in accordance with §265.92(c)(2), using the Student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and, in the case of pH, decreases also).

(2) The calculated arithmetic mean and variance for each indicator parameter specified in §265.92(b)(3) from each downgradient monitoring well is to be individually compared to the initial background arithmetic mean and variance of each indicator parameter, established in accordance with §265.92(c)(2), using the Student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and, in the case of pH, decreases also).

(c) (1) If the evaluations for the upgradient wells, performed in accordance with paragraph (b)(1) above, yield a significant increase (or pH decrease), the owner/operator must record and submit this information in accordance with §265.94.

(2) Based on this information, the Regional Administrator may, at his discretion, require the facility owner/operator to conduct additional sampling and analyses, and revise the facility's background datum.

(d) If the evaluations for downgradient wells, performed in accordance with paragraph (b)(2) above, yield a significant increase (or pH decrease), the facility will be suspected of affecting ground-water quality and the owner/operator must:

(1) Immediately obtain additional ground-water samples from those downgradient wells where a significant difference was detected, split the samples in two, and obtain additional analysis of all samples to determine whether the significant difference was a result of laboratory error.

(2) If the analyses of the split samples confirm the significant increase (or pH decrease), notify, in writing within seven days, the Regional Administrator and appropriate State and local officials, that the facility may be affecting ground-water quality.

(3) Within 15 days of notification, submit to the Regional Administrator for review and approval:

(i) A plan for conducting the damage assessment program, based on the outline prepared previously in accordance with paragraph (a), specifying the number of wells and their locations and depths, and the sampling, analysis, and evaluation procedures to be used to detect and quantify any hazardous waste constituents which may have been discharged from the facility into ground water. The damage assessment plan must be developed in consideration of and specifically related to the hydrogeology of the underlying aquifer.

(ii) Any ground-water quality information, such as that discussed in paragraph (c), which could demonstrate that the facility is not affecting ground-water quality and that a damage assessment is unnecessary.

(e) When instructed by the Regional Administrator, the owner/operator must immediately initiate his damage assessment program, as approved or modified by the Regional Administrator. Within 15 days of completion of the program, the owner/operator must submit to the Regional Administrator and to those State and local officials previously notified in accordance with paragraph (d) above a written report containing the results of the damage assessment and recommended remedial measures.

Comment: Based upon information included in the damage assessment report, the Regional Administrator may: (1) arrange for downgradient ground-water users to be notified; (2) instruct the owner/operator to submit Part B of the application for a permit under Part 122, Subparts A and B; (3) initiate enforcement action under the authority of Section 7003 of the Act; and/or (4) take other appropriate action.

(f) At least annually, the facility owner/operator must evaluate the ground-water surface elevation data obtained under §265.92(e) to determine whether the downgradient monitoring well location requirement under §265.91(a)(2) is no longer satisfied. If the evaluation shows that §265.91(a)(2) is no longer satisfied, the owner/operator must immediately modify the number, location, and/or depth of the monitoring wells to bring the ground-water monitoring system into compliance with this requirement.

265.94 Recordkeeping and Reporting

(a) The facility owner/operator must maintain records of the analyses of samples from all ground-water monitoring wells required in §265.92(c) and (d), the associated ground-water surface elevations required in §265.92(e), and the evaluations required in §265.93, throughout the active life of the facility, and for disposal facilities, throughout the post-closure care period.

(b) The facility owner/operator must report ground-water monitoring information as follows:

(1) Concentrations of the parameters listed in §265.92(b)(1) for each ground-water monitoring well must be submitted to the Regional Administrator within 15 days of the completion of each quarterly analysis during the first year when initial background concentrations are being established for the facility. The owner/operator must separately identify for each monitoring well any parameter whose concentration has been found to exceed the maximum contaminant levels listed in Appendix III.

(2) Concentrations of, and the required evaluation under §265.93(b) for, the parameters listed in §265.92(b)(3) for each ground-water monitoring well must be submitted to the Regional Administrator annually. The owner/operator must separately identify, in accordance with §265.93(c), any significant differences from background found in the upgradient wells. During the active life of the facility, this information must be submitted as part of the annual report required under §265.75.

(3) Results of the evaluation of ground-water surface elevation under §265.93(f), and a description of the response to that evaluation, where applicable, must be submitted to the Regional Administrator as part of the annual report required under §265.75.

265.95 - 265.109 [Reserved]

SUBPART G - CLOSURE AND POST-CLOSURE

256.110 Applicability

Except as provided otherwise in §265.1:

(a) The regulations in this Subpart concerning closure apply to the owners/operators of all hazardous waste management facilities; and

(b) The regulations in this Subpart concerning post-closure apply to the owners/operators of all disposal facilities, i.e., to those facilities at which waste will remain after final closure.

265.111 Closure Performance Standard

All facilities must be closed in a manner that minimizes (1) any discharge of wastes, leachate, contaminated rainfall, or waste decomposition products to ground or surface waters or the atmosphere; and (2) the need for further maintenance to protect the environment and human health.

265.112 Closure Plan; Amendment of Plan

(a) The owner/operator of a facility must develop a closure plan and keep it on the premises. This plan must identify steps necessary to completely close the facility at any point during its expected life, as well as the steps necessary to close at the end of the expected life of the facility. The closure plan must include, but need not be limited to, the following:

(1) A description of how and when the facility will be partially closed, if applicable, and ultimately closed, including an identification of the maximum extent of the operation which will be unclosed during the life of the facility, and a description of how the applicable closure requirements of §§265.197, 265.228, 265.280, and 265.310 will be met;

(2) The maximum inventory of wastes in storage and/or in treatment that is expected during the life of the facility;

(3) A description of the steps necessary to decontaminate facility equipment during closure;

(4) A schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone

dates which will allow tracking of the progress of closure. (For example, the expected date for completion of treatment or disposal of waste inventory must be included, as must the planned date for removal of any residual wastes from storage facilities and treatment processes.)

(b) During the active life of the facility, i.e., that period during which wastes are periodically received, the owner/operator may, at any time, amend his closure plan. The owner/operator must amend his plan anytime changes in operating plans or facility design would affect the closure plan.

(c) An owner/operator of a facility must submit his closure plan to the Regional Administrator at least 180 days prior to the date he expects to begin closure. The Regional Administrator must modify and/or approve the plan within 90 days of receipt. In the event that the owner/operator of a facility plans to begin closure within 180 days of the effective date of these regulations, the owner/operator must submit the necessary plans on the effective date of these regulations.

265.113 Time Allowed for Closure

(a) Within 90 days of receiving the final volume of wastes, the owner/operator must treat and/or remove all wastes in storage or in process from the site, or dispose of them on-site, in accordance with the closure plan.

(b) Closure activities must be completed in accordance with the approved closure plan and within six months of receiving the final volume of wastes. The Regional Administrator may accept a longer closure period if the owner/operator can demonstrate that the required or planned closure activities will, of necessity, take longer than six months to complete and that all steps have been taken to eliminate any substantial threat to human health and the environment from the unclosed but inactive facility.

265.114 Disposal or Decontamination of Equipment

When closure is completed, all facility equipment must have been property disposed of or decontaminated by removal of all hazardous waste and residues.

265.115 Certification of Closure

When closure is completed, the owner/operator must submit to the Regional Administrator certification by the owner/operator and certification by a registered professional engineer that the facility has been closed in accordance with the specifications in the closure plan.

265.116 [Reserved]

265.117 Post-Closure and Use of Property; Period of Care

(a) Post-closure care must consist of at least the following:

(1) Monitoring and reporting in accordance with the requirements of Subpart F; and

(2) Maintenance of monitoring and waste containment systems specified in §§265.91, 265.223, 265.228, 265.280, and 265.311, where applicable.

(b) The Regional Administrator may require maintenance of any or all of the security requirements of §265.14 during the post-closure period when:

(1) wastes remain exposed after completion of closure, or

(2) casual access by the public may pose a hazard to human health.

(c) Post-closure use of property on or in which hazardous waste remains after closure must, in perpetuity, be conducted in a manner that prevents disturbing the integrity of the final cover, liner(s), and any other components of the containment system, and the monitoring systems of the facility, unless the owner/operator can demonstrate to the Regional Administrator that the disturbance:

(1) Is necessary to the proposed use of the property, and will not result in an increase in the potential hazard to human health or the potential for environmental contamination, or

(2) Is necessary to reduce environmental contamination or a threat to human health.

(d) An owner/operator of a disposal facility must provide post-closure care for at least 30 years from the date of the completion of closure. However, the owner or operator may petition the Regional Administrator to allow some or all of the requirements for post-closure care to be discontinued or altered before the end of the 30-year period. The petition must include evidence demonstrating the secure nature of the facility that makes continuing the specified post-closure requirement(s) unnecessary, e.g., no detected leaks and none likely to occur, characteristics of the waste, application of advanced technology, or alternative disposal, treatment, or reuse techniques. At the end of the post-closure period, the Regional Administrator, if he finds that the continued integrity of the site or prior noncompliance with the applicable standards and requirements justifies it, may require the owner/operator to continue one or more of the post-closure care and maintenance requirements contained in the facility's post-closure plan for a specified period of time. At the end of the specified period of time, the Regional Administrator will make a determination whether to continue or terminate post-closure care and maintenance at the facility. Anyone (a member of the public, as well as the owner/operator) may petition the Regional Administrator for an extension or reduction of the post-closure care period based on cause. These petitions will be considered by the Regional Administrator at closure and at five-year intervals after the completion of closure.

265.118 Post-closure Plan; Amendment of Plan

(a) The owner/operator of a disposal facility must develop a post-closure plan and keep it on the premises. This plan must identify the activities which will be carried on after final closure and the frequency of those activities. The post-closure plan must include, but need not be limited to, the following:

(1) Monitoring activities and frequencies as specified in Subpart F for the post-closure period; and

(2) Maintenance activities and frequencies to ensure integrity of the cap and final cover and/or other containment structures as specified in §§265.223, 265.228, 265.280, and 265.311, where applicable, for the monitoring equipment specified in §265.91, and for any security equipment specified by the Regional Administrator in §265.117(b).

(b) At any time during the active life of the facility or during the post-closure care period, the owner/operator may amend his post-closure plan. The owner/operator must amend his plan any time changes in operating plans or facility design would affect his post-closure plan.

(c) The owner/operator of a disposal facility must submit his post-closure plan to the Regional Administrator at least 180 days before he expects to begin closure. The Regional Administrator must modify and/or approve the plan within 90 days of receipt. In the event that the owner/operator of a disposal facility plans to begin closure within 180 days of the effective date of these regulations, the owner/operator must submit the necessary plans on the effective date of these regulations.

265.119 Notice to Local Land Authority

Within 90 days after closure is completed, the owner/operator of a disposal facility must submit to the local land authority and the Regional Administrator a survey plat indicating the location and dimensions of landfill cells, trenches, or other disposal areas, with respect to permanently surveyed benchmarks. This plat must be prepared and certified by a registered professional land surveyor. The plat filed with the local land authority must contain a note, prominently displayed, advising of the owner's/operator's obligation to restrict disturbance of the site as specified in §265.177(c). Additionally, the owner/operator must submit to the Regional Administrator and local land authority a record of the type, location, and quantity of hazardous wastes disposed of within each cell, trench, or area of the facility. For wastes disposed in cells or trenches before these regulations were promulgated, the owner/operator must identify the type, location, and quantity of the wastes to the best of his knowledge and in accordance with any records he has maintained.

265.120 Notice in Deed to Property

The owner of the property on which a disposal facility is located must record a notation on the deed to the facility property or, in accordance with State law, on any other such instrument which is normally examined during title search, that will, in perpetuity, notify any potential purchaser of the property that the land has been used to manage hazardous waste, and of the use restriction of §265.117(c).

265.121 - 265.139 [Reserved]

SUBPART H - FINANCIAL REQUIREMENTS

265.140 Applicability

(a) The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities, except as otherwise provided in this section or in §265.1.

(b) The requirements of §§265.143 and 265.144 apply only to owners/operators of disposal facilities.

(c) Facilities owned by a State or the Federal government are exempted from the requirements of this Subpart.

265.141 Cost Estimate for Facility Closure

(a) On the effective date of these regulations, each facility owner/operator must have an estimate of the cost of closing the facility in accordance with the requirements in §§265.111-265.115 and applicable closure requirements in §§265.197, 265.228, 265.280 and 265.310. The estimate must be for the cost of closure at the point in the facility's operating life when such cost would be at its maximum due to the extent and type of operations at the facility, as indicated by its closure plan (see §265.112(a)). (For example, the closure cost estimate for a particular landfill may be for the cost of closure when its area of active disposal operations is 20 acres, since at all other times the active area will be less than 20 acres. The costs of partial closures that are scheduled to take place, according to the closure plan, before or after the time of maximum closure cost would not be included in the estimate.)

(b) A new closure cost estimate must be prepared by the owner/operator whenever a change in the assumptions on which the closure plan is based, including the type and amount of waste received and the type and extent of operations, would change the cost of closure (see §265.112(b)) and whenever the closure plan changes. The owner/operator must retain the current closure cost estimate at the facility at all times.

(c) On each anniversary date of these regulations, the owner/operator must index the closure cost estimate to the latest published annual Gross National Product Implicit Price Deflator, as published by the U.S. Department of Commerce, and identified in this regulation as the inflation factor. The indexed closure cost estimate is referred to as the adjusted closure cost estimate. The adjusted closure cost (ACC) estimate is calculated as follows:

$$ACC = \frac{CCC}{CIF} \times LIF$$

where ACC = adjusted closure cost,
CCC = current closure cost estimate as determined in paragraph (b),
CIF = current inflation factor, i.e., last inflation factor published prior to the current closure cost estimate, and
LIF = the latest published inflation factor.

265.142 Financial Assurance for Facility Closure

On the effective date of these regulations, each owner/operator must have evidence of financial assurance for facility closure. He must choose from among the following options:

(a) Closure Trust Fund

(1) The owner/operator may establish a closure trust fund. Equal annual payments, in cash or marketable

securities, made over the expected life of the site must add up to the closure cost estimate required by §265.141. Payments must be made by the owner/operator within 30 days of the scheduled annual payment date. The trust agreement must be written so that the trustee will notify the Regional Administrator by certified mail within 15 days of non-receipt by the trustee of a scheduled payment by the owner/operator. Upon receipt of such notification, the Regional Administrator may order the facility to commence closure activities.

(2) When an amendment to the closure cost estimate is made, changes must be equally apportioned among remaining annual payments. For example, if the estimated closure cost is increased by $10,000 and the remaining life of the facility is 10 years, each annual trust fund payment must be increased by $1,000.

(3) As an option, owners/operators may choose to deposit the full amount of the closure cost estimate in the trust at the outset, but the amount must be adjusted annually for inflation in accordance with adjustments to the closure cost estimate (§265.141(c)). An owner/operator may also accelerate payments to the trust, but at no time may the total accumulation in the trust fall below the amount which would have accrued had payments been made as specified in paragraphs (a)(1) and (a)(2).

(4) The trustee may be any bank or other financial institution authorized to act as a trustee in accordance with the laws of the State in which the facility is located.

(5) The beneficiary of the trust fund must be the United States.

(6) In making investments of closure trust funds, the trustee is under a duty to the beneficiary, i.e., the U.S. government, to make only investments that a prudent person would make of his own property, having in view the preservation of the fund and the amount and regularity of the income to be derived.

(7) The terms of the trust must require the trustee to disburse monies from the trust fund to any party designated by the Regional Administrator, as follows:

(i) Upon receipt of itemized bills for closure of the facility from the owner/operator, the Regional Administrator must determine whether they are in accord with the approved closure plan or are otherwise justified in his view. If so, the Regional Administrator must direct the trustee to pay them or reimburse the owner/operator if the amount remaining in the trust after such payment is greater than or equal to 20 percent of the current closure cost estimate. The Regional Administrator, at his discretion, may alternately direct the trustee to pay bills presented by the owner/operator directly without individual approval by EPA if a registered professional engineer has confirmed in writing that such bills have been incurred in accord with the closure plan.

(ii) The Regional Administrator may direct the trustee to disburse monies from the trust fund to any designated party upon a legal determination of a violation of the closure requirements of these regulations rendered in a proceeding brought under Section 3008 of the Act.

(8) A trustee may seek to intervene in any proceeding in which the trustee may become liable to perform in part or in full pursuant to any trust instrument undertaken in accordance with these regulations.

(9) Upon receiving certification by the owner/operator and certification by a registered professional engineer that the facility has been closed in accordance with the closure plan (see §265.115), and having no information indicating that closure may not be satisfactory, the Regional Administrator must direct the trustee to release any remaining funds in the trust to the owner/operator.

(b) Surety Bonds

(1) An owner/operator may meet the requirements of this Section by obtaining a surety bond. Such surety bond must be issued by a surety company authorized to do business in the United States and acceptable to the Agency. To be acceptable to the Agency, a surety company must, at a minimum, be certified by the U.S. Treasury Department in Circular 570 to write bonds in

the penal sum of the bonds to be issued under these Regulations.

(2) Such surety bond must provide assurance of performance by the owner/operator with respect to facility closure in compliance with the closure plan established for the facility. Such surety bond must be written in an amount equal to the closure cost estimate required by §265.141. Such surety bond must be written so that whenever closure activities begin during the term of the bond, the bond coverage includes completion of the closure plan.

(3) An owner/operator must maintain at all times a surety agreement in the amount of the latest adjusted closure cost estimate (see §265.141).

(4) A surety company must send any notice of cancellation to the Regional Administrator by certified mail. Such notice will be effective no less than 90 days after receipt by the Regional Administrator. The owner/operator must send notice to the Regional Administrator by certified mail within three days of receipt of such notice of cancellation from a surety company.

(5) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of closure, as required in this section, is sent by certified mail to the Regional Administrator prior to the 31st day.

(6) A surety becomes liable on a bond obligation only when there has been a legal determination of a violation of the closure requirements of these regulations rendered in a proceeding brought pursuant to the provisions of Section 3008 of the Act. A surety may seek to intervene in any proceeding in which the surety may become liable to perform in part or in full pursuant to any bond undertaken in accordance with these regulations. Following such a determination the surety must:

  (i) Complete the closure requirements in accordance with the closure plan; or

  (ii) Complete the closure requirements by hiring a contractor designated by the Regional Administrator to conduct closure activities in accordance with the closure plan.

(7) The Regional Administrator must notify the surety in writing within 30 days when closure has been accomplished in accordance with the requirements of these regulations.

(c) Letter-of-Credit

(1) An owner/operator may meet the requirements of this Section by obtaining an irrevocable standby-type letter-of-credit. The letter must be written in favor of the Environmental Protection Agency and must be for a period of not less than one year. The letter-of-credit may be issued by any bank which is a member of the Federal Reserve System.

(2) The credit must be issued for an amount equal to the closure cost estimate calculated and adjusted by the owner/operator in accordance with the requirements of §265.141.

(3) An owner/operator must maintain, during the operating life of the facility, a letter-of-credit in the full amount of the latest adjusted closure cost estimate.

(4) The letter-of-credit must contain an "automatic extension" clause, or other clause providing for automatic annual extensions of the credit subject to 60 days written notice by the issuing bank to both the owner/operator and the Regional Administrator of the bank's intention not to continue the credit. Following such notice, the Regional Administrator will have the right, described in the letter-of-credit, to draw upon the credit up to the aggregate amount of the credit. The owner/operator must send notice to the Regional Administrator by certified mail within three days of receipt of such notice of nonrenewal from the bank.

(5) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of closure, as required in this subpart, is sent by certified mail to the Regional Administrator prior to the 31st day.

(6) If the Regional Administrator draws upon the letter-of-credit at any time, the issuing bank must

deposit the amount of the draft immediately and directly into an interest-bearing escrow account where it will remain intact pending a legal determination of the owner's/operator's violation of the closure requirements of these regulations rendered in a proceeding brought pursuant to the provisions of Section 3008 of the Act. Should the owner/operator be found to have violated the closure requirements, the escrow depositary must pay the person or persons designated by the Regional Administrator to complete closure of the facility.

(7) The Regional Administrator must notify the issuing bank in writing within 30 days upon completion by the owner/operator of the closure requirements of Subpart G.

(d) Use of More Than One Type of Financial Instrument

An owner/operator may meet the requirements of this Section by establishing more than one type of financial instrument. Such instruments are limited to a trust fund, surety bond, or letter-of-credit as specified in paragraphs (a), (b), and (c), respectively. However, the sum of the funds available through the combination of instruments must be no less than the closure cost estimate (e.g., a letter of credit may assure half the closure cost and a trust fund the remaining half). The owner/operator must maintain the level of financial assurance provided by the combination of instruments at no less than the latest adjusted closure cost estimate.

(e) Asset Test and Guarantees for Closure

(1) An owner/operator may meet the requirements of this Section by demonstrating that he has the following financial characteristics as measured by current quarterly reports.

(i) Working capital equal to two times the closure and/or post-closure care financial requirements. For an owner/operator with a single site, working capital must be at least twice the amount of the closure cost estimate. Owners/operators with more than one site can aggregate as many as they choose for the purposes of an asset test so long as the sum of the respective closure cost estimates is no more than half the owner's/operator's working capital. For any facilities not included in the aggregation, the owner/operator must establish some other form of assurance of financial responsibility in accordance with these regulations; and

(ii) At least 10 million dollars of net worth; and

(iii) A debt-to-net-worth ratio of not more than four.

(2) If at any time, the financial strength of the owner/operator fails to meet the characteristics of paragraph (e)(1), the owner/operator must obtain evidence of financial assurance through other methods allowed in this Section. If the owner/operator is unable to obtain an alternate financial instrument within 31 days, he must notify the Regional Administrator immediately by registered mail. The Regional Administrator may then order closure activities to commence in accordance with the closure plan.

(3) A corporation meeting the above characteristics may guarantee the compliance of another corporation if it agrees in writing to assume full and complete legal responsibility for that entity's compliance with either or both the closure and post-closure regulations, where applicable.

(f) Public Entities

(1) An owner/operator which is a local (e.g., city or county) public entity may meet the requirements of this Section if backed by annual revenues from property taxes, income taxes, and/or sales taxes equal to 10 times the estimated costs of closures. To be acceptable, such tax receipts must be legally available to cover closure responsibilities, if necessary.

(2) If at any time the annual tax revenues fail to meet the minimum multiples specified in paragraph (f)(1), the owner/operator must obtain evidence of financial assurance through other methods allowed in this Section. If the owner/operator is unable to obtain an alternate financial instrument within 31 days, he must notify the Regional Administrator immediately by

registered mail. The Regional Administrator may then order closure activities to commence in accordance with the closure plan.

265.143 Cost Estimates for Post-Closure Monitoring and Maintenance

(a) One year from the effective date of these regulations, an owner/operator of a disposal facility must have an estimate of the annual cost of post-closure monitoring and maintenance at the site in accordance with the applicable post-closure regulations in §§265.117-265.120, 265.228, 265.280, and 265.310. The cost estimate is referred to in these regulations as the "annual post-closure operating cost estimate."

(b) A new annual post-closure operating cost estimate must be prepared by the owner/operator whenever a change in the assumptions on which the post-closure plan is based, including the type and amount of waste received and the type and extent of operations, would change the cost of post-closure monitoring and maintenance, and whenever the post-closure plan changes (see §265.118(b)). The owner/operator must retain the current annual post-closure operating cost estimate at the facility at all times.

(c) On each anniversary date of these regulations, during the operating life of the facility, the owner/operator must index the annual post-closure operating cost estimate to be the latest published annual Gross National Product Implicit Price Deflator, as published by the U.S. Department of Commerce, and identified in this regulation as the inflation factor. The indexed annual post-closure operating cost estimate is referred to as the adjusted annual post-closure operating cost estimate (APC), which is calculated as follows:

$$APC = \frac{CPC}{CIF} \times LIF$$

where APC = adjusted annual post-closure operating cost estimate,
CPC = current annual post-closure operating cost estimate as determined in paragraph (b),
CIF = current inflation factor, i.e., the last inflation factor published prior to the most recent change in the post-closure cost estimate as specified in paragraph (b), and
LIF = the latest published inflation factor.

265.144 Financial Assurance for Post-Closure Monitoring and Maintenance

One year from the effective date of these regulations, an owner/operator of a disposal facility must have evidence of financial assurance for post-closure care. He must choose from among the following options:

(a) Post-Closure Trust Fund

(1) The owner/operator may meet the requirements of this Section by establishing a post-closure trust fund. Payments must be made by the owner/operator within 30 days of the scheduled annual payment date. The trust agreement must be written so that the trustee will notify the Regional Administrator by certified mail within 15 days of nonreceipt by the trustee of a scheduled payment by the owner/operator. Upon receipt of such notification, the Regional Administrator may require that closure activities commence.

(2) Payments (cash or marketable securities) must be made to the fund annually and adjusted to changes in the adjusted annual post-closure operating cost estimate. For any given year, the trust payment (TP) may be calculated as follows:

$$TP = \frac{OPC \times 30}{OOL} + \frac{(APC - OPC) \times 30}{ROL}$$

where TP = annual trust payment for a given year,
OPC = original annual post-closure operating cost estimate one year after the effective date of these regulations,
OOL = remaining expected operating life of the facility one year after the effective date of these regulations, in years,
APC = adjusted post-closure operating cost estimate, and
ROL = expected remaining operating life of the facility, in years.

(3) As an option, owners/operators may choose to deposit the full amount of the funds required for 30 years of post-closure care (the adjusted post-closure operating cost estimate times 29) in the trust at the outset, but

the amount must be adjusted annually using the inflation factor as discussed in §265.143(c). An owner/operator may also accelerate payments to the trust, but at no time may the total accumulation in the trust fall below the amount which would have accrued had payments been made as specified in paragraph (a)(2).

(4) The trustee may be any bank or other financial institution authorized to act as a trustee in accordance with the laws of the State in which the facility is located.

(5) The beneficiary of any such trust agreement must be the United States.

(6) In making investments of post-closure trust funds, the trustee is under a duty to the beneficiary, i.e., the U.S. government, to make only those investments that a prudent person would make of his own property, having in view the preservation of the fund and the amount and regularity of the income to be derived.

(7) The terms of the trust must require the trustee to disburse monies from the trust fund to any party designated by the Regional Administrator as follows:

   (i) Upon receipt of itemized bills for post-closure activities from the owner/operator, the Regional Administrator must determine whether they are in accord with the approved post-closure plan or are otherwise justified in his view. If so, the Regional Administrator must direct the trustee to pay them or reimburse the owner/operator for the appropriate amount. The Regional Administrator, at his discretion, may alternately direct the trustee to pay bills presented by the owner/operator directly without individual approval by EPA if a registered professional engineer has confirmed in writing that such bills have been incurred in accord with the post-closure plan.

   (ii) The Regional Administrator may direct the trustee to disburse monies from the trust fund to any party upon a legal determination of a violation of the post-closure requirements of these regulations rendered in a proceeding brought under Section 3008 of the Act.

(8) A trustee may seek to intervene in any proceeding in which the trustee may become liable to perform in part or in full pursuant to any trust instrument undertaken in accordance with these regulations.

(9) Reversion of excess funds.

(i) At completion of the post-closure care period, the Regional Administrator must direct the trustee to release any remaining fund in the trust to the owner/operator.

(ii) If, under the provisions of §265.117(c), the Regional Administrator allows discontinuation or alteration of some or all of the requirements of a post-closure plan before the end of the 30-year period, the excess portion of the trust fund must be released by the Regional Administrator.

(b) Surety Bond Guaranteeing a Lump Sum Payment at Closure

(1) An owner/operator may meet the requirements of this Section by obtaining a surety bond. Such surety bond must be issued by a surety company authorized to do business in the United States of America and acceptable to the Agency. To be acceptable to the Agency a surety company must, at a a minimum, be certified by the U.S. Treasury Department in Circular 570 to write bonds in the penal sum of the bonds to be issued under these regulations.

(2) Such surety bond must provide guarantee of payment by the owner/operator, into a trust fund for the purpose of assuring post-closure care, of a lump sum amount equal to the estimate of costs for 30 years of post-closure care calculated and adjusted by the owner/operator in accordance with the requirements of §265.143. The trust fund is to be established prior to commencement of closure activities by the owner/operator.

(3) An owner/operator must maintain, during the operating life of the facility, a surety agreement guaranteeing lump sum payment in the full amount of the costs for 30 years of post-closure care calculated and adjusted in accordance with §265.143.

(4) A surety company must send notice of cancellation to the Regional Administrator by certified mail. Such notice shall be effective no less than 90 days after receipt by the Regional Administrator. The owner/operator must send notice to the Regional Administrator by certified mail within three days of receipt of such notice of cancellation from the surety company.

(5) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of post-closure activities, as required in this Section, is sent by certified mail to the Regional Administrator prior to the 31st day.

(6) A surety becomes liable on a bond obligation only when the owner/operator fails to deposit the full amount of the costs of 30 years of post-closure activities in a trust fund designated for that purpose in compliance with the provisions of paragraph (a). The surety obligation comes due on the 31st day following the date closure activities are to commence in accordance with paragraph (b)(5). Discharge of the obligation is accomplished by placing the assured funds in a trust fund as directed by the Regional Administrator.

(7) The Regional Administrator must notify the surety within 60 days of the commencement of closure by certified mail that the owner/operator has:

(i) Established the necessary trust instrument; or

(ii) Defaulted. The Regional Administrator will then direct the surety in the placement of funds in a trust.

(c) Letter-of-Credit Ensuring a Lump-Sum Payment at Closure

(1) An owner/operator may meet the requirements of this Section by obtaining an irrevocable standby-type letter-of-credit. The letter must be written in favor of the Environmental Protection Agency and must be for a period not less than one year. The letter-of-credit may be issued by any bank which is a member of the Federal Reserve System.

(2) The credit must be issued for an amount equal to the estimate of costs for 30 years of post-closure care calculated and adjusted by the owner/operator in accordance with the requirements of §265.143.

(3) An owner/operator must maintain, during the operating life of the facility, a letter of credit in the full amount of the costs for 30 years of post-closure care calculated and adjusted in accordance with §265.143.

(4) The letter-of-credit must contain an "automatic extension" clause, or other clause providing for automatic annual renewal of the letter-of-credit subject to a 60-day minimum period of prior written notice by the issuing bank to both the owner/operator and the Regional Administrator, of the bank's intention not to continue the credit. Following such notice, the Regional Administrator will have the right, described in the letter of credit, to draw upon the credit up to the aggregate amount of the credit. The owner/operator must send notice to the Regional Administrator by certified mail within three days of receipt of such notice of nonrenewal from the bank.

(5) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of post-closure activities as required in this Section is sent by certified mail to the Regional Administrator prior to the 31st day.

(6) The Regional Administrator may draw on the credit provided only when the owner/operator fails to deposit the full amount of the costs of 30 years of post-closure activities in a trust fund designated for that purpose in compliance with the provisions of paragraph (a). The Regional Administrator may not draw on the credit until the 15th day following the date closure activities are to commence in accordance with paragraph (c)(5). The Regional Administrator must deposit any funds drawn from the bank into an interest bearing escrow account unless and until he authorizes disbursement to third parties. The Regional Administrator's request to draw funds must be made to the bank by certified mail.

(7) The Regional Administrator must notify the issuing bank in writing within 30 days upon completion by the owner/operator of the requirements of this Section.

(d) Surety Bond Guaranteeing Performance of Post-Closure Duties

(1) An owner/operator may meet the requirements of this Section by obtaining a surety bond. Such surety bond must be issued by a surety company authorized to do business in the United States and acceptable to the Agency. To be acceptable to the Agency, a surety company must, at a minimum, be certified by the U.S. Treasury Department in Circular 570 to write bonds in the penal sum of the bonds to be issued under these regulations.

(2) Such surety bond must provide guarantee of performance by the owner/operator with respect to the post-closure monitoring and maintenance requirements in fulfillment of the post-closure plan required in §265.118.

(3) Such surety bond must be written in an amount equal to the costs for 30 years of post-closure care calculated and adjusted in accordance with §265.143.

(4) Such surety bond must be written so that whenever closure activities begin or are ordered to begin by the Regional Administrator during the term of the bond, the bond coverage must extend to completion of the post-closure care period or 30 years, whichever is shorter.

(5) An owner/operator must maintain, during the operating life of the facility, a surety agreement in the full amount of the costs for 30 years of post-closure care, calculated and adjusted in accordance with §265.143.

(6) As post-closure obligations are completed, the penal sum of the bond must be reduced commensurately, so that the balance of the penal sum of the bond will equal the remaining cost obligations of the owner/operator for post-closure care. The Agency, at the request of the owner/operator, will send written notice to the surety of any reduction in the required penal sum within 30 days of receipt by the Agency of such request.

(7) A surety company must send notice of cancellation to the Regional Administrator by certified mail. Such notice will be effective no less than 90 days after receipt by the Regional Administrator. The owner/operator must send notice to the Regional

Administrator by certified mail within three days of receipt of such notice from the surety company.

(8) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of post-closure activities, as required in this Section, is sent by certified mail to the Regional Administrator prior to the 31st day.

(9) A surety becomes liable on a bond obligation only when there has been a legal determination of a violation of the post-closure requirements of these regulations rendered in a proceeding brought pursuant to the provisions of Section 3008 of the Act. A surety may seek to intervene in any proceeding in which the surety may become liable to perform in part or in full pursuant to any bond undertaken in accordance with these regulations. Following such a determination, the surety must:

(i) Discharge the post-closure requirements in accordance with the post-closure plan, or

(ii) Discharge the post-closure requirements by hiring a contractor designated by the Regional Administrator to conduct post-closure activities in accordance with the post-closure plan.

(10) The Regional Administrator must notify the surety within 60 days of the end of the post-closure care period or the end of the 30 years of post closure care, whichever comes earlier, that the owner/operator has discharged his obligations to that point.

(e) Letter-of-Credit Ensuring Funds for the Performance of Post-Closure Duties

(1) An owner/operator may meet the requirements of this Section by obtaining an irrevocable standby-type letter-of-credit. The letter must be written in favor of the Environmental Protection Agency and must be for a period of not less than one year. The letter-of-credit may be issued by any bank which is amember of the Federal Reserve System.

(2) The credit must be issued for an amount equal to the costs for 30 years of post-closure care calculated and

adjusted by the owner/operator in accordance with the requirements of §265.143. As post-closure obligations are completed as the post closure period progresses, the credit guarantee may be reduced commensurately, so that the remaining credit will equal the remaining cost obligations of the owner/operator for post-closure care. The Agency, at the request of the owner/operator, will send written notice to the bank ofany reduction in the required credit guarantee within 30 days of receipt by the Agency of such request.

(3) Such letter of credit must contain provisions that whenever closure activities begin or are ordered to begin by the Regional Administrator while it is in effect, the credit guarantee must extend to completion of the post-closure care period or for 30 years, whichever is shorter.

(4) An owner/operator must maintain, during the operating life of the facility, a letter of credit in the full amount of the costs for 30 years of post-closure care calculated and adjusted in accordance with §265.143.

(5) The letter-of-credit must contain an "automatic extension" clause, or other clause providing for automatic annual renewal of the letter-of-credit subject to a 60-day minimum period of prior written notice by the issuing bank to both the owner/operator and the Regional Administrator, of the bank's intention not to continue the credit. The owner/operator must send notice to the Regional Administrator by certified mail within three days of receipt of such notice of nonrenewal from the bank.

(6) An owner/operator must begin closure activities on the 31st day after receiving a cancellation notice unless other evidence of financial assurance of post-closure activities, as required in this Section, is sent by certified mail to the Regional Administrator prior to the 31st day.

(7) The Regional Administrator may draw on the credit provided only when there has been a legal determination of a violation of the post-closure requirements of these regulations rendered in a proceeding brought pursuant to the provisions of Section 3008 of the Act. Following such determination, the Regional Administrator may draw on the credit up to the limit of the

guarantee, directing the funds to contractors or other individuals for purposes ofcarrying out the post closure responsibilities in accordance withthe post-closure plan.

(8) The Regional Administrator must notify the issuing bank in writing within 30 days of the completion of the post-closure care period or 30 years, whichever is less, that the owner/operator has discharged his obligations to that point.

(f) Use of More Than One Type of Financial Instrument

An owner/operator may meet the requirements of this Section by establishing more than one type of financial instrument. Such instruments are limited to a trust fund, surety bonds, or letters of credit as specified in paragraphs (a) through (e). However, the sum of the funds available through the combination of instruments must be no less than the estimate of costs for 30 years of post-closure care calculated and adjusted in accordance with §265.143.

(g) Asset Test and Guarantees for Post-Closure Care

(1) An owner/operator may meet the requirements of this Section by demonstrating that he has the following financial characteristics as measured by current quarterly reports:

(i) Working capital equal to two times the closure and/or post-closure financial requirements. For an owner/operator with a single site, working capital must be at least 60 times the amount of the current adjusted annual post-closure cost estimate. Owners/operators with more than one site can aggregate as many as they choose for the purposes of an asset test so long as the sum of 60 times the respective current adjusted annual post-closure cost estimates is no more than half the owner's/operator's working capital. For any facilities not included in the aggregation, the owner/ operator must establish some other form of assurance of financial responsiblity in accordance with these regulations; and

(ii) At least 10 million dollars of net worth; and

(iii) A debt-to-net-worth ratio of not more than four.

(2) If at any time, the financial strength of the owner/operator fails to meet the characteristics of paragraph (g)(1), the owner/operator must obtain evidence of financial assurance through other methods allowed in this Section. If the owner/operator is unable to obtain an alternate financial instrument within 31 days, he must notify the Regional Administrator immediately by registered mail. The Regional Administrator may then order closure activities to commence in accordance with the closure plan.

(3) A corporation meeting the above characteristics may guarantee the compliance of another corporation if it agrees in writing to assume full and complete legal responsiblity for that entity's compliance with either or both the closure and post-closure regulations, where applicable.

(h) Public Entities

(1) An owner/operator which is a local (e.g., city or county) public entity may meet the requirement of this Section if backed by annual revenues from property, sales, and/or income taxes equal to 10 times the estimated current adjusted annual post-closure cost estimate. To be acceptable, such tax receipts must be legally available to cover post-closure responsibilities, if necessary.

(2) If at any time, the annual tax revenues fail to meet the minimum multiples specified in paragraph (h)(1), the owner/operator must obtain evidence of financial assurance through other methods allowed in this Section. If the owner/operator is unable to obtain an alternate financial instrument within 31 days, he must notify the Regional Administrator immediately by registered mail. The Regional Administrator may then order closure activities to commence in accordance with the closure plan.

265.145 - 265.148 [Reserved]

265.149 Applicability of State Financial Requirements

(a) If a facility is located in a State in which existing hazardous waste regulations require that owners/operators must provide financial assurance for facility closure and for post-closure monitoring and maintenance, an owner/

operator may use an existing State-authorized financial mechanism in meeting financial assurance requirements of §265.142 and §265.144, provided that:

(1) The State-authorized mechanism is a mechanism allowed in §265.142 for closure or §265.144 for post-closure monitoring or maintenance, or

(2) The State mechanism provides a similar degree of assurance (e.g., escrow account) as do the mechanisms of §265.142 for closure and §265.144 for post-closure.

The owner/operator must obtain an additional financial assurance mechanism for closure and for post-closure, chosen from §265.142 for closure and §265.144 for post-closure care, if the amount of assurance from the State mechanisms is less than that from the mechanisms of this Subpart. The total amount of financial assurance provided by the combination of the State and Federal mechanisms must equal at least the amount of assurance required in §§265.142 and 265.144.

(b) If a State assumes legal responsibility for the closure and/or post-closure requirements of Subpart G or assures that funds will be available from State sources to cover these requirements, the owner/operator will be in compliance with the requirements of this Subpart.

265.150 Transfer of Ownership

(a) An owner/operator of a hazardous waste management facility with interim status is liable for the financial responsibility requirements of these regulations until he has completely discharged all of his obligations. If an owner/operator transfers ownership/operation of the facility during the interim status period, the transfer or owner/operator will remain liable for the financial responsibility requirements of the facility unless and until:

(1) The transferee owner/operator complies with the financial requirements of these regulations and submits Part A of the permit application within 30 calendar days of closing, if the facility continues to operate; and

(2) The transferor owner/operator transmits to Regional Administrator a copy of a written agreement between the transferor owner/operator and the transferee owner/operator which contains an

acknowledgement that the transferor owner/operator is liable for the financial responsibility requirements under these regulations up to a specific date and that the transferee owner/operator is liable on and after that date.

(b) Any security, including money, property, or commercial paper, set aside for the purposes of meeting the financial responsibility requirements of these regulations will not be released until the conditions of paragraph (a) are met.

(c) Any security which will be returned at the direction of the Regional Administrator, including trust funds, must be returned when the Regional Administrator is satisfied that the transferor has completely discharged all his obligations under these regulations.

265.151-265.169 [Reserved]

SUBPART I - USE AND MANAGEMENT OF CONTAINERS

265.170 Applicability

The regulations in this Subpart apply to the owners/operators of all hazardous waste management facilities that handle containers of hazardous waste, except as provided otherwise in §265.1.

265.171 Condition of Containers

A container holding hazardous waste must be in good condition and must not leak. If a container is not in good condition, or if it begins to leak, the owner/operator must transfer the hazardous waste from the container to a storage container that is in good condition, or manage the waste in another fashion which complies with the requirements of this Part.

265.172 Compatibility of Waste with Container

Owners/operators must use containers made of materials which will not react with, or are otherwise compatible with, the waste to be stored, unless the container is protected by a nonreactive lining.

265.173 Management of Containers

(a) Storage containers must be closed to all times during storage, except when it is necessary to add or remove wastes.

(b) Owners/operators must manage an emptied fibrous, metal, plastic, or glass container that is a hazardous waste listed under Part 261 in accordance with the requirements of this Part. However, these requirements do not apply if the container:

(1) Is triple rinsed using a solvent or other liquid capable of removing the hazardous waste residue, or is cleaned using another method that has been shown in the scientific literature or by the owner's/operator's testing to remove residue to the same degree; or

(2) Is refilled with a compatible nonwaste material; or

(3) Is sent to a facility that recovers material or energy values in a manner which does not constitute disposal (see Part 261); or

(4) Has been protected from contact with the waste by an inner liner which has been removed.

Comment: An inner liner which has been removed from a container that previously held hazardous waste is a hazardous waste, unless it complies with the provisions of paragraph (b)(1), (2), or (3) above (see Part 261). Reuse of containers is also governed by U.S. Department of Transportation regulations, including those set forth in 49 CFR 173.28.

265.174 Inspections

In addition to the inspections required by §265.15, the owner/operator must inspect areas where containers are stored, at least weekly, looking for deterioration caused by corrosion or other factors and leaks.

Comment: See §265.171 for remedial action required if deterioration or leaks are detected.

265.175 [Reserved]

265.176 Special Requirements for Ignitable or Reactive Waste

Containers holding ignitable or reactive waste must be located more than 15 meters (50 feet) from the facility's property line.

Comment: See §265.36 for additional requirements.

265.177 Special Requirements for Incompatible Waste

(a) Incompatible wastes (see Appendix V for examples) must not be placed in the same container.

(b) Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material (see Appendix V for examples).

(c) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored in other containers, piles, or impoundments nearby must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device. The purpose of this is to prevent gaseous emissions, leaching, or other discharge of hazardous wastes or hazardous constituents which could result from the mixing of incompatible materials.

265.178 - 265.189 [Reserved]

SUBPART J - TANKS

265.190 Applicability

The regulations in this Subpart apply to the owners/operators of facilities that use tanks for the treatment and/or storage of hazardous waste, except as provided otherwise in §265.1.

265.191 Construction Requirements

(a) The materials used for the construction of tanks, or the liners used to protect them, must be compatible under expected storage, treatment, and operating conditions (e.g., temperature and pressure) with the hazardous waste to be stored or treated, and with the chemical reagents, if any, that are expected to be used, so that the ability of the tank to contain wastes and reagents during the intended life of the tank is not impaired.

(b) Facilities at which hazardous waste is continuously fed into tanks must be equipped with a means to stop the inflow of waste to the tank (e.g., with a waste feed cutoff system or bypass system to a standby tank) in the event of a leak or overflow from the tank due to a system failure (e.g., a malfunction in the treatment process, a crack in the tank, etc.).

265.192 General Operating Requirements

(a) All treatment of hazardous waste in tanks must be conducted in accordance with the results of the waste analyses and trial tests required in §265.193.

(b) Hazardous wastes or treatment reagents that could cause a tank to rupture, leak, corrode, or otherwise fail prior to closure, or prior to the end of the intended life of the tank, must not be placed in the tank.

(c) Uncovered tanks must be operated to ensure a minimum of 60 centimeters (2 feet) of freeboard, unless the tank is equipped with a containment (e.g., dike or trench), drainage control, and/or diversion (e.g., standby tank) structure which has a capacity that equals or exceeds the volume of the top 60 centimeters (two feet) of the tank.

265.193 Waste Analysis and Trial Tests

In addition to the waste analysis required by §265.13, whenever a tank is used to:

(1) Treat and/or store a new or substantially different waste; or

(2) Treat hazardous waste with a new or substantially different process than that previously used at the facility;

the owner/operator must, to ensure compliance with §§265.192(a) and (b), 265.198, and 265.199:

(1) Conduct waste analyses and trial treatment or storage tests (e.g., bench scale or pilot plant scale tests); or

(2) Obtain documented information on similar storage or treatment of similar waste under similar operating conditions;

to show that this treatment and/or storage will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the tank or otherwise threaten human health or the environment.

Comment: The owner/operator must record the results from each waste analysis and trial test in the operating record of the facility (see §265.73).

265.194 Inspections

In addition to the inspections required by §265.15, the owner/operator of a tank must inspect, where present, the following:

(1) Spill control equipment (e.g., waste feed cutoff systems, bypass systems, and drainage systems) at least once each operating day, to assure that it is in good working order;

(2) Data gathered from monitoring equipment (e.g., pressure gauges and waste level indicators), at least once each operating day, to assure that the facility is being operated according to its design;

(3) The construction materials of the tank, at least weekly, to detect corrosion or leaking of fixtures and seams; and

(4) The construction materials of, and the ground surrounding, spill confinement structures (e.g., dikes), at least weekly, to detect erosion or obvious signs of leakage (e.g., wet spots or dead vegetation).

265.195 [Reserved]

265.196 Ground-Water Monitoring

In some circumstances, the owner/operator of a tank may be required by the Regional Administrator to comply with all or part of the ground-water monitoring requirements of Subpart F. See §265.90(b) for details.

265.197 Closure

At closure, all hazardous waste and hazardous waste residues must be removed from tanks.

> Comment: By removing residues from a tank, the owner/operator becomes a generator of waste and must determine whether the waste is a hazardous waste under Part 261. If the residue is a hazardous waste, the owner/operator must manage it in accordance with all applicable requirements of Parts 262, 263 and 265 of this Subchapter.

265.198 Special Requirements for Ignitable or Reactive Waste

(a) Ignitable or reactive waste must not be placed in a tank, unless:

  (1) The waste is treated, rendered, or mixed immediately after entering the tank so that the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste, respectively, under Part 261; and such treatment will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the tank, or otherwise threaten human health or the environment; or

  (2) The waste is stored or treated in such a way that it is protected from any material or conditions which may cause the waste to ignite or react; or

  (3) The tank is used solely for emergency events.

(b) The owner/operator of a facility which treats or stores ignitable or reactive waste in covered tanks must comply with the National Fire Protection Association's (NFPA's) buffer zone requirements for tanks, contained in Tables 2-1 through 2-6 of the "Flammable and Combustible Code -1977."

Comment: See §265.36 for additional requirements.

265.199 Special Requirements for Incompatible Waste

(a) Incompatible wastes (see Appendix V for examples) must not be placed in the same tank unless they are stored or treated in such a way that they will not generate fumes, fires, or explosive reactions that could damage the structural integrity of the tank, or otherwise threaten human health or the environment.

(b) Hazardous waste must not be stored or treated in unwashed tanks which previously held an incompatible waste or material, unless such storage or treatment will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the tank, or otherwise threaten human health or the environment.

265.200-265.219 [Reserved]

SUBPART K - SURFACE IMPOUNDMENTS

265.220 Applicability

The regulations in this Subpart apply to the owners/operators of facilities that use surface impoundments for the treatment, storage, and/or disposal of hazardous waste, except as provided otherwise in §265.1.

265.221 [Reserved]

265.222 General Operating Requirements

(a) All treatment of hazardous waste in a surface impoundment must be conducted in accordance with the results of the waste analyses and trial tests required in §265.225.

(b) Hazardous wastes or treatment reagents that could cause a surface impoundment to rupture, leak, or otherwise fail prior to closure, or prior to the end of the intended life of the surface impoundment, must not be placed in the surface impoundment.

(c) A surface impoundment must maintain enough freeboard to prevent any overtopping of the dike by overfilling, wave action, or storm event. At a minimum, 60 centimeters (2 feet) of freeboard must be provided.

Comment: Any discharge from the surface impoundment to waters of the United States is subject to the requirements of Section 402 of the Clean Water Act, as amended.

265.223 Containment System

All earthen dikes must have a protective cover, such as grass, shale, or rock, to minimize wind and water erosion and to preserve its structural integrity.

265.224 [Reserved]

265.225 Waste Analysis and Trial Tests

In addition to the waste analyses required by §265.13, whenever a surface impoundment is used to:

(1) Treat and/or store a new or substantially different waste; or

(2) Treat hazardous waste with a new or substantially different process than that previously used at the facility;

the owner/operator must, to ensure compliance with §§265.222(a) and (b), 265.229, and 265.230:

(1) Conduct waste analyses and trial treatment or storage tests (e.g., bench scale or pilot plant scale tests); or

(2) Obtain documented information on similar storage or treatment of similar waste under similar operating conditions;

to show that this treatment and/or storage will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the impoundment, or otherwise threaten human health or the environment.

Comment: The owner/operator must record the results from each waste analysis and trial test in the operating record of the facility (see §265.73).

265.226 Inspections

In addition to the inspections required by §265.15, the owner/operator must:

(a) Inspect the surface impoundment, including dikes and vegetation surrounding the dike, at least once a week to detect any leaks, deterioration, or failures in the impoundment, and

(b) Inspect at least once each operating day to assure that the freeboard level established to comply with §265.222(b) is maintained.

265.227 [Reserved]

265.228 Closure and Post-Closure

The closure plan required in Subpart G must address one of the following means of closure:

(a) Wastes remain in the impoundment after closure.

(1) The surface must have no free liquids.

(2) Closure for the impoundment must be the same as for a landfill. The closure plan and post-closure care are the same as required for a landfill in §§265.310 and 265.311, respectively.

(b) Wastes are removed from the impoundment:

(1) After waste removal, the underlying soil must be quantitatively analyzed for the constituents for which the impounded wastes were determined to be hazardous, if they are listed in Part 261, and any additional substances which the Regional Administrator may require.

(2) If any substance in paragraph (b)(1) is found, the surface impoundment must either close as a landfill pursuant to §265.310 as determined by the Regional Administrator or the remaining contaminated waste must be removed.

Comment: By removing residues from the impoundment, the owner/operator becomes a generator of waste and must determine whether the waste is a hazardous waste under Part 261. If the residue is a hazardous waste, the owner/operator must manage it in accordance with all applicable requirements of Parts 262, 263, and 265.

265.229 Special Requirements for Ignitable or Reactive Waste

Ignitable or reactive waste must not be placed in a surface impoundment, unless:

(1) The waste is treated, rendered, or mixed immediately after entering the impoundment so that the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste, respectively, under Part 261; and such treatment will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the impoundment, or otherwise threaten human health or the environment; or

(2) The waste impoundment is used solely for emergency events.

265.230 Special Requirements for Incompatible Waste

Incompatible wastes (see Appendix V for examples) must not be placed in the same surface impoundments, unless they will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the impoundment, or otherwise threaten human health or the environment.

265.231-265.249 [Reserved]

SUBPART L - WASTE PILES

265.250 Applicability

The regulations in this Subpart apply to the owners/operators of facilities that treat or store hazardous waste in piles, except as provided otherwise in §265.1.

265.251 Protection from Wind

Owners/operators of piles containing hazardous waste which is subject to dispersal by wind must cover or otherwise manage the pile so that wind dispersal does not occur.

265.252 Waste Analysis

In addition to the waste analyses required by §265.13, owners/operators who receive hazardous wastes from other generators, off-site, must analyze a sample from each incoming shipment of waste before adding it to any existing pile, unless the only wastes the facility receives which are amenable to piling are compatible with each other. The analysis conducted must be capable of differentiating between the types of hazardous waste which are placed in piles, so that mixing of incompatible waste does not inadvertently occur. At a minimum, the analysis must include a visual comparison of color and texture.

265.253 Containment

(a) Waste piles must be constructed to divert external runoff away from the pile and to collect runoff from the pile unless:

(1) The waste does not meet the characteristics of a toxic hazardous waste in Part 261, and is immobile under the runoff conditions likely to be encountered in the area; or

(2) The pile is protected from precipitation and runoff by some other means.

(b) Waste piles must be placed on an impermeable base that is compatible with the waste under the conditions of storage, unless the waste does not meet the characteristics of a toxic hazardous waste in Part 261.

Comment: Piles not meeting these requirements will be regulated as landfills under Subpart N.

265.254 [Reserved]

265.255 Special Requirements for Ignitable Waste

Ignitable waste must not be stored in a pile, unless the addition of the waste to an existing pile results in the waste or mixture no longer meeting the definition of ignitable waste under Part 261; and such addition will not generate heat, fumes, fires, or explosive reactions that could damage the pile's containment structures, if any, or otherwise threaten human health or the environment.

265.256 Special Requirements for Reactive Waste

Reactive waste must not be stored in a pile, unless:

(1) Addition of the waste to an existing pile results in the waste or mixture no longer meeting the definition of reactive waste under Part 261; and such addition will not generate heat, fumes, fires, or explosive reactions that could damage the pile's containment structures, if any, or otherwise threaten human health or the environment; or

(2) The waste is managed in such a way that it is protected from any material or condition which may cause it to react.

265.257 Special Requirements for Incompatible Waste

(a) Incompatible wastes (see Appendix V for examples) must not be placed in the same pile.

(b) A pile of hazardous waste that is incompatible with any waste or other material stored in other containers, piles, or impoundments nearby must be separated from the other materials, or protected from them by means of a dike, berm, wall, or other device. The purpose of this is to prevent gaseous emissions, leaching, or other discharge of hazardous wastes or hazardous constituents which could result from the mixing of incompatible materials.

265.258-265.269 [Reserved]

SUBPART M - LAND TREATMENT

265.270 Applicability

The regulations in this Subpart apply to owners/operators of hazardous waste land treatment facilities, except as provided otherwise in §265.1.

265.271 [Reserved]

265.272 General Operating Requirements

Runoff from the land treatment facility which has been in contact with hazardous waste must be collected and treated or disposed. At a minimum, the collection, treatment, and disposal system must be capable of handling the flow from the 24-hour, 25-year storm event. The effective date of this Section is 12 months after the effective date of this Part.

Comment: If such collected runoff is discharged to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended. This requirement will prohibit all untreated nonpoint source seepage or flow onto adjacent land and into waters of the United States.

265.273 Waste Analysis

(a) In addition to the waste analyses required by §265.13, the owner/operator must:

(1) Conduct waste analyses as necessary to comply with §§265.281 and 265.282;

(2) Determine the concentrations in the waste of the following elements: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, unless the owner/operator has documented data that shows that one or more of these elements is not present;

(3) Determine the concentrations of any additional substances for which the waste is listed as a hazardous waste in Part 261, if it is listed;

(4) Determine the pH of the waste; and

(5) If food chain crops are being grown on the facility, conduct a complete chemical analysis of the waste, including solubility.

Comment: EPA's background document for Part 261 specifies the substances for which a waste is listed as a hazardous waste.

(b) Waste analyses are required for all substantially different wastes received, unless the owner/operator has the documented information necessary to comply with §§265.13(b), 265.281, and 265.282 for similar treatment or disposal of similar wastes under similar operating conditions.

265.274 [Reserved]

265.275 [Reserved]

265.276 Food Chain Crops

(a) Food chain crops must not be grown on the treated area of a land treatment facility, unless the owner/operator has in his possession and can provide upon request from the Regional Administrator the following information based on actual field tests and/or extensive research:

(1) Analysis of the waste according to §265.273, and

(2) Evidence that the hazardous constituents determined under §265.273(a)(2) and (a)(3) will:

(i) not be transferred to the food portion of the crop by plant uptake or direct contact, and that ingestion by food chain animals (e.g., by grazing) will not occur, or

(ii) not be greater in concentration in the crops grown on the treated area than in similar regional crops grown on untreated soils.

(b) The information developed in paragraph (a) must be for the specific waste being land treated; the specific waste application rates; the specific soil types, considering pH, and cation exchange capacity; and the specific crops involved.

Comment: If the owner/operator grows food chain crops on the land treatment facility, the information developed in this Section must be submitted with Part B of the application for a permit under Section 122, Subparts A and B.

265.277 [Reserved]

265.278 Zone of Aeration Monitoring

(a) The owner/operator must develop and implement a zone of aeration monitoring plan which will provide information on the vertical migration of waste constituents under the treated area(s) of the land treatment facility. The plan must employ, at a minimum, the following two types of monitoring:

(1) Soil monitoring using soil cores, and

(2) Soil-pore water monitoring using lysimeters.

(b) The owner/operator must take into consideration waste type and the following relationships when developing the monitoring plan:

(1) Soil-core depth and depth of the lysimeter(s) as a function of the depth to which the waste is incorporated into the soil;

(2) Number of soil cores and number of lysimeters as a function of the variability of the measured parameters, the soil types and waste types; and

(3) Frequency and timing of sampling as a function of frequency, time, and rate of waste application, proximity to ground water, and soil permeability.

(c) At a minimum, three soil cores and three lysimeters must be tested annually.

(d) The owner/operator must analyze the soil cores and samples from the lysimeters for the elements that were found in the waste during the waste analysis of §265.273(a)(2), and any constituents for which the waste was listed as a hazardous waste in Part 261.

Comment: All data and information developed by the owner/operator under this Section must be submitted with Part B of the application for a permit under Part 122, Subparts A and B.

265.279 Recordkeeping

The owner/operator of a land treatment facility must maintain the following additional items in the operating record required in 265.73:

(a) Records of the application dates, quantities, and location of each hazardous waste placed in the facility;

(b) Results of the zone of aeration monitoring carried out under §265.278, and the rationale used in developing the monitoring plan;

(c) Results of any monitoring or testing of food chain crops under §265.276; and

(d) Results of any monitoring or analysis carried out in development or implementation of a closure plan under §265.280.

265.280 Closure and Post-Closure

(a) The closure and post-closure plans required in Subpart G must address the following objectives:

(1) Control of the leaching of contaminants from the treated area into the ground water;

(2) Control of the release of contaminated runoff from the facility into surface water;

(3) Control of the release of airborne particulate contaminants caused by wind erosion; and

(4) Compliance with §265.276 concerning the uptake and marketing of food-chain crops grown on the facility, if any.

(b) The owner/operator must consider at least the following factors in addressing the closure objectives of paragraph (a):

(1) Type of waste and waste constituents in the facility;

(2) The characteristics of the waste and waste constituents including mobility and leachability;

(3) Site location, topography, and surrounding land use, with respect to the potential impact caused by pollutant migration (e.g., proximity to ground water, surface water and drinking water sources);

(4) Climate including amount, frequency, and pH of precipitation;

(5) Geological and soil profile of the site and soil characteristics, including cation exchange capacity, total organic carbon, and pH;

(6) Zone of aeration monitoring information obtained under §265.278;

(7) Type, concentration, and depth of contaminants added to the soil;

(8) Expected rate of any contaminant migration;

(9) Removal of contaminated soils;

(10) Cover material and final surface contours, functions of the cover (e.g., infiltration control, erosion/runoff control, and wind erosion control), and its characteristics (e.g., thickness, porosity and permeability, slope, length of run of slope, and amount and type of vegetation);

(11) Collection and treatment of runoff;

(12) Diversion structures to prevent surface water runon from entering the treated area; and

(13) Monitoring after closure.

(c) During the post-closure care period, the owner/operator of a land treatment facility must:

(1) Maintain any zone of aeration or ground-water monitoring systems and collect and analyze samples from these systems in a manner and frequency specified in the post-closure plan;

(2) Restrict access to the facility as appropriate for its post-closure use; and

(3) Assure that no activities (e.g., growth of food chain crops) occur on a closed land treatment facility which may threaten human health or the environment.

265.281 Special Requirements for Ignitable or Reactive Waste

Ignitable or reactive wastes must not be land treated, unless the waste is immediately incorporated into the soil so that the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste, respectively, under Part 261; and such incorporation does not generate heat, fumes, fires, or explosive reactions that could negatively affect the biological activity or attenuation capacity of the facility, or otherwise threaten human health or the environment.

265.282 Special Requirements for Incompatible Waste

Incompatible wastes (see Appendix V for examples) must not be land treated in the same treatment area, unless:

(a) Land treatment makes them compatible via chemical, physical, or biological mechanisms; and

(b) Such treatment will not generate heat, fumes, fires, or explosive reactions that could negatively affect the biological activity or attenuation capacity of the facility, or otherwise threaten human health or the environment.

265.283-265.299 ·[Reserved]

SUBPART N - LANDFILLS

265.300 Applicability

The regulations in this Subpart apply to owners/operators of facilities that dispose of hazardous waste in landfills, except as provided otherwise in §265.1.

265.301 [Reserved]

265.302 General Operating Requirements

Runoff from the landfill which has been in contact with hazardous waste must be collected and treated or disposed. At a minimum, the collection, treatment, and disposal system must be capable of handling the flow from the 24-hour, 25-year storm event. The effective date of this Section is 12 months after the effective date of this Part.

Comment: If such collected runoff is discharged to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended. This requirement will prohibit all untreated nonpoint source seepage or flow into surface waters of the United States.

265.303 Waste Analysis

(a) In addition to the waste analyses required by §265.13, the owner/operator must determine the pH of the waste and conduct waste analyses as necessary to comply with §§265.312 and 265.313.

(b) Waste analyses are required for all substantially different wastes received, unless the owner/operator has the documented information necessary to comply with §§265.13, 265.312, and 265.313 for disposal of similar wastes under similar operating conditions.

265.304-265.308 [Reserved]

265.309 Surveying and Recordkeeping

The owner/operator of a landfill must maintain the following additional items in the operating record required in §265.73:

(a) On a map, the exact location and dimensions, including depth, of each cell with respect to permanently surveyed benchmarks;

(b) The contents of each cell and the general location of each hazardous waste type within each cell; and

(c) If the waste was accompanied by a manifest, the specific manifest number as a part of the record of the location of each hazardous waste.

265.310 Closure

The closure and post-closure plans required in Subpart G must include a final cover over the landfill, the function and design of the cover, and the post-closure care requirements of §265.311.

(a) The following objectives must be addressed in the plan:

(1) Control of pollutant migration;

(2) Control of surface water infiltration; and

(3) Erosion prevention.

(b) The owner/operator must consider the following factors in addressing the objectives of paragraph (a):

(1) Type of waste and waste constituents in the landfill;

(2) The characteristics of the waste and waste constituents including mobility and leachability;

(3) Site location and topography with respect to the potential impact caused by pollutant migration (e.g.,

proximity to ground-water, surface water and drinking water sources);

(4) Climate including amount, frequency and pH of precipitation;

(5) Cover material and its characteristics, such as porosity and permeability;

(6) Cover thickness;

(7) Cover slope and length of run of slope; and

(8) Amount and type of vegetation.

265.311 Post-Closure Care

During the post-closure care period, the owner/operator of a hazardous waste landfill must:

(1) Maintain the function and integrity of the final cover as specified in the approved closure plan;

(2) Maintain the ground-water monitoring system and collect and analyze samples from this system in the manner and frequency specified in Subpart F;

(3) Maintain and monitor the leachate collection and removal system (if there is one present in the landfill) and remove and treat any leachate collected in a manner and frequency to prevent excess accumulation of leachate in the system;

(4) Maintain and monitor the gas collection and control system (if there is one present in the landfill) to control the vertical and horizontal escape of gases;

(5) Protect and maintain surveyed benchmarks; and

(6) Restrict access to the landfill as appropriate for its post-closure use.

Comment: See §265.117(b) and (c) for additional requirements during the post-closure care period.

265.312 Special Requirements for Ignitable or Reactive Waste

Ignitable or reactive waste must not be placed in a landfill, unless the waste is treated, rendered, or mixed immediately after placement in the landfill so that the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste, respectively, under Part 261; and such treatment will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the landfill, or otherwise threaten human health and the environment.

265.313 Special Requirements for Incompatible Waste

Incompatible wastes (see Appendix V for examples) must not be placed in the same landfill cell, unless they will not generate heat, fumes, fires, or explosive reactions that could damage the structural integrity of the landfill, or otherwise threaten human health or the environment.

265.314 Special Requirements for Liquid Waste

(a) Bulk liquid waste and noncontainerized waste having free liquids (e.g., sludges) must not be placed in a landfill, unless the landfill has a functioning liner and leachate collection and removal system, the liner is chemically resistant to the added liquid, and the collection and removal system has a capacity sufficient to remove all leachate produced.

Comment: This requirement does not apply if, prior to disposal, the bulk liquid waste or waste containing free liquids is treated and/or stabilized, chemically or physically, such that free liquids are no longer present.

(b) Containerized liquid waste is prohibited from disposal in a landfill.

(c) The requirements of this Section are effective six months after the effective date of this Part.

265.315-265.339 [Reserved]

SUBPART O - INCINERATORS

265.340 Applicability

The regulations in this Subpart apply to owners/operators of facilities that treat hazardous waste in incinerators, except as provided otherwise in §265.1.

265.341 [Reserved]

265.342 [Reserved]

265.343 General Operating Requirements

The owner/operator must bring his incinerator to steady state (normal) conditions of operation, such as temperature and air flow, using auxiliary fuel or other means, before adding hazardous wastes.

265.344 [Reserved]

265.345 Waste Analysis

(a) In addition to the waste analyses required by §265.13, the owner/operator must analyze any waste which he has not previously burned in his incinerator. The analysis performed on this waste must be sufficient to allow the owner/operator to establish steady state (normal) operating conditions (including waste and auxiliary fuel feed and air flow) and to determine the type of pollutants which might be emitted. At a minimum, the analysis must determine the following:

(1) Heating value of the waste;

(2) Halogen content and sulfur content;

(3) Concentration of the following elements: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, unless the owner/operator has documented

data that shows that one or more of these elements is not present; and

(4) Concentration of the toxicant(s) in any waste which caused it to be listed as a toxic hazardous waste in Part 261, if it is listed.

(b) Owners/operators who receive hazardous wastes from other generators, off-site, must analyze a sample from each incoming shipment of waste before incinerating it. In the case of drum shipments, as a minimum, owners/operators must sample one drum of each waste in that shipment. The analysis conducted must be sufficient to determine that the waste actually received is substantially the same as that analyzed under paragraph (a) (i.e., that a mistake in labeling has not been made by the generator). At a minimum, this must include a visual and/or instrumental comparison for color, texture, opacity, solids content, viscosity, and pH.

265.346 [Reserved]

265.347 Monitoring and Inspections

In addition to the inspections required by §265.15, the owner/operator must conduct, as a minimum, the following monitoring and inspections when incinerating hazardous waste:

(a) Existing instruments which relate to combustion and emission control must be monitored at least every 15 minutes. Appropriate corrections to maintain steady state combustion conditions must be made immediately either automatically or by the operator. Examples of instruments which relate to combustion and emission control would normally include those measuring waste feed, auxiliary fuel feed, air flow, incinerator temperature, scrubber flow, scrubber pH, and relevant level controls.

(b) Stack plume (emissions) must be observed visually at least hourly for normal appearance (color and opacity). Any indicated operating corrections necessary to minimize visible emissions must be made immediately by the operator.

(c) At least daily, the complete incinerator and associated equipment (pumps, valves, conveyors, pipes, etc.) must be inspected for leaks, spills, and fugitive emissions, and all emergency shutdown controls and system alarms must be checked to assure proper operation.

265.348-265.350 [Reserved]

265.351 Closure

At closure, the owner/operator must remove all residues (including but not limited to ash, scrubber waters, and scrubber sludges) from the incinerator.

Comment: By removing residues from an incinerator, the owner/operator becomes a generator of waste and must determine whether the waste is a hazardous waste under Part 261. If the residue is a hazardous waste, the owner/operator must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Subchapter.

265.352 Open Burning; Explosive Waste

An owner/operator must not open burn hazardous wastes, unless those wastes are explosive. Those choosing to detonate an explosive waste in the open must do so more than 500 meters (550 yards) from the facility property line and in a manner that does not threaten the environment or human health outside the facility.

265.353-265.999 [Reserved]

APPENDIX I

RECORDKEEPING INSTRUCTIONS

The recordkeeping provisions of §265.73 specify that an owner/operator of a facility must keep an operating record. This appendix provides additional instructions as to the manner in which portions of the operating record are to be kept. See §265.73(b) for additional recordkeeping requirements.

The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility in the following manner:

Records of each hazardous waste received, treated, stored, or disposed of at the facility, which include the following:

(1) If the waste is listed in §261.--, a description by its EPA hazardous waste list number. If the waste is not listed in §261.--, a description by its EPA hazardous waste characteristic(s) number as defined in §261.--, its common name, and the process that produced it (for example, filter cake from production of ----).

Each hazardous waste listed in §261.--, and each hazardous waste characteristic or combination of characteristics defined in §261.--, has a unique four-digit number assigned to it. This number must be used for recordkeeping and reporting purposes.

The waste description must also include the waste's physical form, i.e., liquid, sludge, solid, or contained gas.

(2) The estimated or manifest-reported weight, or volume and density, where applicable, in one of the units of measure specified in Table 1; and

(3) The method(s) (by handling code(s) as specified in Table 2) and date(s) of treatment, storage, and/or disposal.

TABLE 1

Unit of Measure	Symbol*	Density
Pounds	P	--
Short Tons	T	--
Gallons	G	P/G
Cubic Yards	Y	T/Y
Kilograms	K	--
Tonnes	M	--
Liters	L	K/L
Cubic Meters	C	M/C

*Single digit symbols are used here for data processing purposes.

TABLE 2

HANDLING CODES FOR TREATMENT, STORAGE, AND DISPOSAL METHODS

Enter the handling code(s) listed below that most closely represents the technique(s) used at the facility to treat, store, or dispose of each quantity of hazardous waste received.

1. Storage

S01	Container (barrel, drum, etc.)
S02	Tank
S03	Waste pile
S04	Surface impoundment
S05	Other (specify)

2. Treatment

(a) Thermal Treatment

T06	Pyrolysis
T07	Rotary kiln incinerator
T08	Fluidized bed incinerator
T09	Cement kiln incinerator
T010	Multiple hearth incinerator
T011	Electrical utility boiler
T012	Liquid injection incinerator
T013	Sludge incinerator
T014	Chemical waste incinerator
T015	Process heater
T016	Lime kiln
T017	Wood waste incinerator
T018	Other (specify)

(b) Chemical Treatment

T19	Cyanide destruction
T20	Chemical oxidation
T21	Chemical precipitation
T22	Chemical reduction
T23	Neutralization
T24	Degradation
T25	Chlorination
T26	Chemical fixation
T27	Detoxification
T28	Absorption mound
T29	Absorption field

T30	Ion exchange
T31	Other (specify)

(c) Physical Tratment

(1) Separation of Components

T32	Centrifugation
T33	Clarification
T34	Filtration
T35	Flocculation
T36	Sedimentation
T37	Decanting
T38	Coagulation
T39	Flotation
T40	Foaming
T41	Thickening
T42	Encapsulation
T43	Surface impoundment
T44	Holding tank
T45	Other (specify)

(2) Removal of Specific Components

T45	Blending
T47	Catalysis
T48	Distillation
T49	Evaporation
T50	Solvent Recovery
T51	Stripping
T52	Absorption - molecular sieve (activated carbon)
T53	Crystallization
T54	Sand filter
T55	Dialysis
T56	Electrodialysis
T57	Leaching
T58	Reverse osmosis
T59	Other (specify)

(d) Biological Treatment

T60	Land treatment
T61	Activated sludge
T62	Aerobic lagoon
T63	Anaerobic lagoon
T64	Spray irrigation
T65	Thickening filter
T66	Waste stabilization pond
T67	Septic tank

T68	Aerobic tank
T69	Other (specify)

3. Disposal

D70	Chemical waste landfill
D71	Land treatment (to be closed as a landfill)
D72	Surface impoundment (to be closed as a landfill)
D73	Ocean disposal
D74	Deep well injection
D75	Other (specify)

Appendix II

EPA Report Form
and
Instructions

…ease print or type. Form designed for elite type (*12 characters/inch*). *Form Approved OMB No. 158-R00XX*

EPA U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE ANNUAL REPORT

(Collected under the authority of Section 3002 of RCRA.)

I. IDENTIFICATION NUMBER F … T/A C I

OFFICIAL USE ONLY *(date received & review…*

REVIEWER'S NAME

II. NAME OF BUSINESS

III. BUSINESS REPRESENTATIVE
A. NAME
B. TELEPHONE NUMBER *(area code & no.)*

IV. BUSINESS ADDRESS *(street or route no., city, & zip code)*

V. TYPE OF REPORT
☐ A. GENERATOR
☐ B. FACILITY
☐ C. UNMANIFESTED

VI. CLOSING DATE *(list y…*

VII. WASTE INFORMATION *(continue on reverse if necessary)*

IDENTIFIER	A. IDENTIFICATION NUMBER	B. INTERNATIONAL SHIPMENT (mark 'X')	C. WASTE DESCRIPTION — 1. DOT HAZARD CLASS (mark 'X'): a. COMBUSTIBLE	b. CORROSIVE	c. ETIOLOGIC AGENT	d. EXPLOSIVE A	e. EXPLOSIVE B	f. FLAMMABLE GAS	g. FLAMMABLE LIQUID	h. FLAMMABLE SOLID	i. IRRITATING AGENT	j. NON-FLAMMABLE GAS	k. ORGANIC PEROXIDE	l. ORM-E	m. OXIDIZER	n. POISON A	o. POISON B	p. RADIOACTIVE	2. EPA: ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) (see instructions)	D. AMOUNT OF WASTE	E. UNIT OF MEASURE (enter code)	F. DENSITY (enter number)	G. HANDLING CODE (enter code(s))
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							

EPA Form 8700-13 (12-79)

Continue On Reverse

Continued From Front

NO. 1 2 13 14

VII. WASTE INFORMATION *(continued from front)*

IDENTIFIER	A. IDENTIFICATION NUMBER	B. INTERNATIONAL SHIPMENT *(mark 'X')*	C. WASTE DESCRIPTION 1. DOT HAZARD CLASS *(mark 'X')* a. COMBUSTIBLE	b. CORROSIVE	c. ETIOLOGIC AGENT	d. EXPLOSIVE A	e. EXPLOSIVE B	f. FLAMMABLE GAS	g. FLAMMABLE LIQUID	h. FLAMMABLE SOLID	i. IRRITATING AGENT	j. NON-FLAMMABLE GAS	k. ORGANIC PEROXIDE	l. ORM-E	m. OXIDIZER	n. POISON A	o. POISON B	p. RADIOACTIVE	2. EPA ENTER THE EPA WASTE CODE(s) IF AVAILABLE, OTHERWISE, ENTER THE EPA HAZARD CLASS CODE(s) *(see instructions)*	D. AMOUNT OF WASTE	E. UNIT OF MEASURE *(enter code)*	F. DENSITY *(enter number)*	G. HANDLING CODE *(enter code(s))*
12																							
13																							
14																							
15																							
16																							
17																							

VIII. COMMENTS

IX. CERTIFICATION

I certify under penalty of law that I have personally examined a am familiar with the information submitted in this and all attacl documents, and that based on my inquiry of those individuals i mediately responsible for obtaining the information, I believe tl the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false i formation, including the possibility of fine and imprisonment.

SIGNATURE

NAME *(type or print)*

DATE SIGNED

EPA Form 8700-13 (12-79) REVERSE

DETAILED INSTRUCTIONS: HAZARDOUS WASTE MANAGEMENT REPORT

This report must be completed annually by all hazardous waste treatment, storage, and disposal facilities in compliance with hazardous waste regulations (40 CFR Part 264) under the authority of the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901).

Part I

Item I. Facility ID Number

The facility identification number requested here for private, municipal, and State-owned facilities is the Data Universal Numbering System, or otherwise called the DUNS Number, developed by Dunn and Bradstreet, Inc. Most business establishments in the United States have already been assigned DUNS numbers, including all types and sizes of business establishments, branches, factories, distribution centers, and purchasing units. State and municipal facilities, including publicly owned treatment works, have also been assigned DUNS numbers.

All facilities engaged in the generation, transport, and treatment, storage, and disposal of hazardous waste will be assigned a facility identification number under the authority of Section 3010 of RCRA as part of the Hazardous Waste Facility Notification program.

If you need to find out the DUNS number for your business, you can obtain this information free of charge by calling the nearest office of Dunn and Bradstreet, Inc.

For Federal facilities, the General Services Administration (GSA) real property number should be used. All Federal facilities have already been assigned a real property number by GSA. If you don't know your number, call the nearest local office of GSA.

Fill in the number as follows:

- STATE CODE - In the first two positions of the number insert the U.S. Postal Service State Code for the appropriate State or territory in which the facility is located, such as PA, MD, NJ, NY, OR MA;
- DUNS OR GSA Identifier and Number - In the remaining positions after the State code insert a "D" for a private, municipal, or State-owned facility followed by the nine-digit DUNS number; OR insert a "G" for a Federally-owned facility followed by the GSA number.

EXAMPLES

1. Private facility __________ PAD784621382 in Pennsylvania.
2. Federal facility __________ NYG284370155 in New York.
3. State facility __________ CAD362429824 in California.

Item II: RCRA Permit Number

Give the number of the presently effective RCRA permit issued to the facility, or if you have previously filed an application but have not yet received a permit, give the number of the application, if any.

Item III: Reporting Period

Enter the calendar year or the closing date of the period for which the report is made.

Item IV: Name of Facility

The facility is the distinct activity or installation, under the responsibility of the owner or operator, legally required to complete and submit this report.

Name the facility as it is officially or legally referred to in order to distinguish it from similar entities in the same geographical area. Do not use colloquial names as a substitute for the official name.

Item V: Facility Contact

Give the name, title, and work telephone number of a person who is thoroughly familiar with the operation of the facility and with the facts reported and who can be contacted by reviewing offices if necessary.

Item VI: Facility Mailing Address

Give the complete mailing address of the facility's main office, where correspondence should be sent. This often will not be the same address used to designate the location of the facility or activity.

Item VII: Facility Location

Give the location of the facility identified in Item IV of this form.

Items VIII-IX: [Reserved]

Item X: Owner Information

Under Item X-A, enter the name, as it is legally referred to, of the person, firm, public organization, or any other entity which owns or is directly responsible for hazardous waste activity described in this report. This may or may not be the same as the facility or activity producing the waste. Do not use colloquial names as a substitute for the official name.

Under item X-B enter the appropriate letter to indicate the type of ownership. Indicate "public" for a facility solely owned by local government(s) such as a city, town, county, parish, etc.

Under items C, D, E, F, and G, enter the telephone number and address of the owner identified in item X-A.

Item XI: Comments [Reserved]

Item XII: Certification

Federal statutes provide for severe penalties for submitting false information on this. 18 U.S.C. Section 1001 provides that "Whoever, in any matter within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals or covers up by any trick, scheme, or device a material fact, or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both."

In addition, Section 3008(d) of the Resource Conservation and Recovery Act provides for a fine up to $25,000 or imprisonment up to one year for a first conviction for making a false statement in any report under the Act, and for double these penalties upon subsequent convictions.

The facility owner/operator, or his authorized representative, must sign and date the certification.

PART II

Item I: Facility I.D. Number

Enter the facility identification number as described under Item I of Part I on each attached form.

Item II: Numbering of Attachments

The responsible official certifying Part I shall initial each attached form. Each attached sheet must be numbered as the second of two, the second, and the third of three, and so on, so all sheets are sequentially identified.

Item III: Reporting Period

Enter the calendar year or the closing date of the period for which the report is made.

Item IV: Waste Information

IV-A: Waste Source

Enter the generator of record for the described waste by the identification number and the facility legal name. Enter the identification number in the first 12 spaces as described under Item I Part I instructions. Enter the facility legal name in the remaining spaces.

If more than one waste from the same generator is listed, enter only the facility identification number for each waste after the first, under waste source.

For international shipments, enter the name, address, and country of origin of the generator, or the name and address of the importer of record.

For unmanifested wastes, enter the identification number, the legal name of the generator, and the identification number and name of the transporter, if known.

For wastes generated and treated, stored or disposed at the site of generation, enter the generator identification number.

IV-B:

Enter a description of each waste corresponding to the generator or source entered in column IV-A.

Describe each waste or aggregated waste stream managed at your facility during the reporting period by a name using the specific manufacturing or other process generating the waste; the common name of the waste; and the exact chemical or generic chemical name of the waste, if known.

For wastes that are listed under the RCRA waste regulations (40 CFR 261.14), enter the listed name, abbreviated if necessary, and the EPA waste code. (See IV-C below.)

IV-C:

Enter the four-digit EPA hazardous waste list number for listed waste, or for the major component of a mixture of more than one listed waste.

For unlisted wastes, enter the four-digit EPA hazardous waste characteristic(s) number. (See §261.--.)

IV-D:

Enter an EPA handling code for each waste. Where more than one EPA handling code would apply, report only the code representing the current status or final disposition of the waste at your facility. Handling codes are given in Table 2 of Appendix I.

IV-E: Waste Amount

Enter the waste amount, converted to metric tons, for each waste.

APPENDIX III

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

Parameter	Maximum Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Flouride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2, 4-D	0.1
2, 4, 5-TP Silvex	0.01
Radium	5 pCi/l
Gross Alpha	15 pCi/l
Gross Beta	4 millirem/yr
Turbidity	1/TU
Coliform Bacteria	1/100 ml

APPENDIX IV

Tests for Significance

As provided in §264.93(c), the owner/operator must use the Student's t-test for determination of statistically significant differences in ground-water monitoring data. For three of the ground-water monitoring indicator parameters (total organic carbon, total organic halogen, and specific conductance) a single tailed Student's t-test must be used to test for significant differences at the 0.01 level for increases over background. The difference test for pH must be a two-tailed Student's t-test at the 0.01 level of significance.

The number of replicate measurements (i.e., number of times measurements will be made on a single sample of well water) to be made on each sample must be determined separately for each indicator. The number of replicate measurements must, at a minimum, provide for a 95 percent confidence interval with relative precision (i.e., the interval length expressed as a percentage of the sample mean) equal to or less than 10 percent. The minimum number of replicates required may be different for different parameters and measurement techniques as a result of variability of individual measurement techniques, both procedures and equipment.

Specification of a 95 percent confidence interval, precision equal to or less than 10 percent, and testing at the 0.01 significance level, are included to minimize the possibility of not detecting significant differences.

Methods for determining the minimum number of replicates (sample size) for various specifications can be found in most introductory statistics texts (such as Dixon, W.J. and F.J. Massey, 1969. "Introduction to Statistical Analyses." McGraw-Hill, New York, pp. 270-273).

APPENDIX V

Examples of Potentially Incompatible Waste

Many hazardous wastes, when mixed with other waste or materials at a hazardous waste facility, can produce adverse human health and environmental effects such as (1) heat or pressure generation, (2) violent reaction, (3) generation or release of flammable or toxic fumes and gases, (4) fire or explosions, (5) release of toxic substances in case of fire or explosion, and (6) generation of flammable or toxic gases.

Below are examples of potentially incompatible wastes, waste components, and materials, along with the adverse consequences which result from mixing materials in one group with materials in another group. The list is intended as a guide to owners/operators of treatment, storage, and disposal facilities, and to enforcement and permit granting officials, to indicate the need for special precautions when managing these potentially incompatible waste materials or components.

It is possible for potentially incompatible wastes to be mixed in such a way as to preclude a reaction (e.g., adding acid to water rather than water to acid) or to neutralize each other (e.g., a strong acid mixed with a strong base).

The mixing of a Group A materials with a Group B materials may have the potential consequence as noted.

Group 1-A	Group 1-B
Acetylene sludge	Acid sludge
Alkaline caustic liquids	Acid and water
Alkaline cleaner	Battery acid
Alkaline corrosive liquids	Chemical cleaners
Alkaline corrosive battery fluid	Electrolyte, acid
Caustic wastewater	Etching acid liquid or solvent
Lime sludge and other corrosive alkalies	Liquid cleaning compounds
Lime wastewater	Pickling liquor and other corrosive acids
Lime and water	Spent acid
Spent caustic	Spent mixed acid
	Spent sulfuric acid

Potential consequences: Heat generation, violent reaction.

Group 2-A	Group 2-B
Asbestos waste, and other toxic wastes	Cleaning solvents
Beryllium wastes	Data processing liquid
Unrinsed pesticide containers	Obsolete explosives
Waste pesticides	Petroleum waste
	Refinery waste
	Retrograde explosives
	Solvents
	Waste oil and other flammable and explosive wastes

Potential consequences: Release of toxic substances in case of fire or explosion.

Group 3-A	Group 3-B
Aluminum	Any waste in Group 1-A or 1-B
Beryllium	
Calcium	
Lithium	
Magnesium	
Potassium	
Sodium	
Zinc powder and other reactive metals and metal hydrides	

Potential consequences: Fire or explosion: generation of flammable hydrogen gas.

Group 4-A	Group 4-B
Alcohols	Any concentrated waste in Groups 1-A or 1-B
Water	Calcium
	Lithium
	Metal hydrides
	Potassium
	SO_2Cl_2, $SOCL_2$, PCL_3, CH_3SiCl_3, and other water-reactive wastes

Potential consequences: Fire, explosion, or heat generation: generation of flammable or toxic gases.

Group 5-A	Group 5-B
Alcohols	Concentrated Group 1-A or 1-B wastes
Aldehydes	Group 3-A wastes
Halogenated hydrocarbons	
Nitrated hydrocarbons and other reactive organic compounds and solvents	
Unsaturated hydrocarbons	

Potential consequences: Fire, explosion or violent reaction.

Group 6-A	Group 6-B
Spent cyanide and sulfide solutions	Group 1-B wastes

Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.

Group 7-A	Group 7-B
Chlorates and other strong oxidizers	Acetic acid and other organic acids
Chlorine	Concentrated mineral acids
Chlorites	Group 2-B wastes
Chromic acid	Group 3-A wastes
Hypochlorites	Group 5-A wastes and other flammable and combustible wastes
Nitrates	
Nitric acid, fuming	
Perchlorates	
Permanganates	
Peroxides	

Potential consequences: Fire, explosion, or violent reaction.

Source: "Law, Regulations and Guidelines for Handling of Hazardous Waste." California Department of Health, February 1975.

PART 266 - STANDARDS FOR OWNERS AND OPERATORS OF FACILITIES THAT TREAT, STORE, AND/OR DISPOSE OF WASTE IDENTIFIED FOR DISCRIMINATE STANDARDS

Subpart A - General

266.10 Definitions
266.11 - 266.19 [Reserved]

Subpart B - Uranium Mining and Phosphate Rock Mining, Beneficiation, and Processing Waste

266.20 Applicability
266.21 Recordkeeping
266.22 Warning Signs
266.23 Restrictions on Waste Use
266.24 Closure Requirements
266.25 - 266.999 [Reserved]

SUBPART A - GENERAL

266.10 Definitions

Terms used in this Part have the following meanings:

(1) "Habitable structure" means any building enclosure in which people may reside or work.

(2) "Phosphate beneficiation slimes" means that material of extremely fine particle size (clay and colloidal) which are generated in the beneficiating of phosphate rock.

(3) "Sub-ore" means the uranium ore of a grade that is not presently economically feasible to recover for milling.

(4) "Leach zone" means that portion of the original phosphate ore matrix where the phosphate concentration has been decreased to below economically recoverable levels due to natural leaching processes.

[§§266.11 - 266.19 Reserved]

SUBPART B - URANIUM MINING AND PHOSPHATE ROCK MINING, BENEFICIATION, AND PROCESSING WASTE

266.20 Applicability

(a) The regulations in §§266.21 - 266.23 apply to owners/operators of facilities that treat, store, and/or dispose of all wastes from uranium mining and phosphate rock mining, beneficiation, and processing which are listed in Part 261 as hazardous waste due to radioactivity.

(b) The regulations in §266.24 apply only to owners/operators of facilities that treat, store, and/or dispose of sub-ore and other discarded materials from uranium surface mining, the leach zone overburden and discarded phosphate ore from phosphate surface mining, and the slimes from phosphate ore beneficiation as listed in Part 261.

266.21 Recordkeeping

The owner/operator must maintain a record of the location and type of waste deposits on reference maps throughout the operating life of the facility. Owners of facilities in which hazardous waste will remain after closure must record a notation on the deed to the facility property or on such other instrument, in accordance with State law, which is normally examined during title search, that will in perpetuity notify any potential purchaser of the property of the location and type of hazardous waste disposed therein.

266.22 Warning Signs

A sign warning of the radioactivity of the waste and prohibiting the scavenging of these hazardous wastes must be posted and maintained at intervals surrounding the facility such that the warning is readily discernible from any approach to the facility, unless scavenging would be highly unlikely due to the geographic location of the facility. The legend must be written in English and in any other language predominant in the area surrounding the facility.

266.23 Restriction on Waste Use

The wastes may not be disposed of by using them as fill around or under habitable structures (unless meeting the closure requirements of §266.24) or by incorporating them into any building materials of potential use for construction of habitable structures.

266.24 Closure Requirements

(a) Hazardous uranium and phosphate surface mining and beneficiation wastes (as listed in Part 261) must be disposed either during facility operation or before facility closure by covering the wastes with non-hazardous overburden in a stable configuration to a depth of no less than 5 meters (16 feet), unless the owner/operator submits to the Regional Administrator for his review and approval, no later than 180 days before closure, supporting evidence which demonstrates that:

(1) It is highly improbable that habitable structures would ever be built on the disposal facility due to geographic location, available water, projected urban growth, population trends, or other factors; and/or

(2) It is impractical to meet the requirement because the quantity of non-hazardous overburden readily available is not sufficient to meet the specified 5 meter cover requirement.

(b) In the case of paragraphs (a)(1) and (a)(2), along with the required evidence, the owner/operator must submit an alternate closure plan to the Regional Administrator which will provide adequate protection against radiation exposure after facility closure. The plan must address factors such as, but not limited to, the following:

(1) The radioactivity level of the waste;

(2) Projected depth of cover and its effectiveness in inhibiting radon diffusion; and

(3) Use of geologic barriers to prevent radon diffusion.

(c) After the Regional Administrator reviews, modifies as necessary, and approves the alternate closure plan, the owner/operator must implement the plan.

(d) After cover, if required, if applied, the disposal site must be stabilized and revegetated in a manner that supports life indigenous to the surrounding area, unless:

(1) A substance species provides an equivalent degree of stability to the soil, and/or

(2) As determined by the governing State and/or Federal reclamation regulations, returning the land to a beneficial use at the earliest possible date does not require revegetating with such plant life.

APPENDIX O
COMMENT LETTERS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

This appendix presents the text of the seven comment letters received on the Draft Environmental Impact Statement. Four of the commenters included their comments on the Draft Environmental Impact Statement within their much larger comments submitted on the entire Subtitle C regulations. In these four cases, only those portions of the comments that apply to the Draft Environmental Impact Statement are included in this appendix. Each commenter is listed below, along with an indication of whether the entire text of the comment is presented.

Commenter	Text
American Textile Manufacturers Institute, Inc.	Entire text
U.S. Department of Commerce	Entire text
Department of Health, Education and Welfare, Public Health Service	Entire text
The Utility Solid Waste Activities Group and The Edison Electric Institute	EIS comments only
Mobil Oil Corporation	EIS comments only
American Petroleum Institute	EIS comments only
Dow Chemical U.S.A.	EIS comments only

0.1 American Textile Manufacturers Institute, Inc.

0180 DC 1001 IA

AC

AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC.
1101 CONNECTICUT AVENUE, N.W., SUITE 300, WASHINGTON, D.C. 20036
TWX: 710-822-9489
TEL: 202/862-0500

March 6, 1979

MAR 19 1979

Mr. Alan Corson
Hazardous Waste Management Division
Office of Solid Waste (WH-565)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Corson:

On behalf of the American Textile Manufacturers Institute and its member companies, we hereby request a 60-day extension of the comment period for proposed section 3001 regulations. The requested extension is from March 16, 1979, to May 15, 1979.

Although ATMI and its member companies have been reviewing these proposed regulations since their publication on December 18, 1978 many of the implications and ramifications are just now becoming apparent. For example, the inclusion of certain textile wastewater sludges on the hazardous list under section 3001 is based upon a report which is generally recognized to be based upon inadequate data. At the same time, EPA has proposed that publicly owned treatment works (POTW's) be excluded from coverage under these regulations despite the fact that available data shows them to be even more "hazardous" than textile sludges. The justification for separate handling of POTW sludges under section 405 and 402 of the Clean Water Act, i.e., to avoid duplicative permitting, seems to be politically rather than environmentally motivated. Very frankly, we find this disparate treatment unjustified and arbitrary.

The December 18, 1978, Federal Register notice states that the economic, environmental and regulatory impact analysis for these proposed regulations will be available for inspection on January 8, 1979. We have just received a copy of this report and we are unable to review it in depth and prepare comments within the present comment period.

Many other aspects of these regulations are so involved and complex that meaningful review, analysis and comment are impossible by March 16, 1979. For example, although it is proposed that a generator may declare his waste hazardous rather than having to go to the expense of having the wastes tested, it is not stated how the labeling, containerizing, manifesting and disposal of such "declared" hazardous wastes will be handled. Similarly, the validity of the proposed extraction procedure cannot be evaluated in the short period allowed for comment. In view of the strong difference of opinion between EPA and ASTM over the validity of various procedures, this concern is a serious one.

In conclusion, the deadline set for comments effectively makes it impossible for us to make meaningful, constructive comments regarding the proposed regulations. If comments such as those we are attempting to prepare are not considered by EPA, we feel certain that the final regulations will be inadequate and subject to challenge.

Thank you for your consideration of this request.

Sincerely,

OJay Niles

O'Jay Niles, Director
Government Relations/Regulatory

0.2 U.S. Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-3111

March 13, 1979

Mr. Michael Shannon
U.S. Environmental Protection Agency
401 M St. S.W.
Washington, D.C. 20460

Dear Mr. Shannon:

This is in reference to your draft environmental impact statement entitled "Resource Conservation and Recovery Act of 1976, Subtitle C." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving five copies of the final statement.

Sincerely,

Sidney R Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure: Memo from
NOAA-National Ocean Survey

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

March 6, 1979

OA/C22x1:RS

TO: PP - Richard L. Lehman

THRU: OA/C22 - P. Kilho Park

FROM: OA/C22x1 - Ronald Sellers

SUBJECT: Review of DEIS 7902.02 Subtitle C, Resource Conservation and Recovery Act of 1976 (EPA)

We have reviewed the subject documents and submit the following comments and questions for consideration:

1. Page 1x Preface Section 3002 differences

Generators who ship hazardous waste to a foreign country are required to inform the foreign government. Are generators required to inform foreign countries if the material is only in transit through their country? (In the case of material being shipped through the Panama Canal to be disposed of at sea, is the generator required to notify Panama?)

2. Section 7.2.5 Land Use Impacts

Epic long-term capacity of land filling was not addressed. It is stated that "existing land uses would cease, either permanently or temporarily, on all land converted to hazardous waste management uses. Some agricultural, grazing, forest, recreational, and other lands could be removed from their existing uses." With a hazardous waste production of 4.7 million metric tons per year (table 5-21), it seems that 1.3 square miles of land could be filled with a 20-foot thick layer each year. Elsewhere in the document and in recently-issued proposed regulations in the Federal Register, EPA discusses total current volumes of hazardous waste in the 35 million ton per year range, a figure that is expected to grow rapidly in the next few decades. How many years can we continue land filling on the scale this implies before the decrease in available land through waste containment has a significant effect on food production and other land uses?

3. Page 7-202, "Sites at which hazardous wastes have not been removed would be precluded from residential and agricultural uses, and may be precluded from some recreational and grazing uses following closure."

If the intent of limiting the use to non-agricultural purposes is to keep highly persistent molecules out of the food chain, it will not work due to wild animals, insects, and birds foraging on plants in the site area. We recommend this concept be reviewed.

4. Page 5-31, section 5.2.3.5, Waterway Transport

An impact that is not discussed is the possibility of a marine accident that would cause the release of up to 1,500 tons of hazardous waste into the Mississippi River or Gulf intercoastal waterways.

A discussion of the probability of it happening, similar to the discussion on page 7-190 for highway transportation, would be useful.

cc:
C2

0.3 Department of Health, Education, and Welfare, Public Health Service

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333
TELEPHONE: (404) 633-3311

March 12, 1979

Mr. Michael Shannon
Office of Solid Waste, WH-565
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mr. Shannon:

We have reviewed the draft environmental impact statement for Subtitle C, Resource Conservation and Recovery Act of 1976. We are responding on behalf of the Center for Disease Control.

The following comments are offered for your consideration:

1. The EPA Standards, as proposed, would not apply to a generator producing less than 100 kilograms of hazardous waste per month. While this amount might not be considered significant for some chemicals, 100 kilograms of radioactive material or infectious material could present a substantial problem if proper handling, storage, transportation, and disposal practices are not observed.

2. The proposed standards would not apply to a generator who stores hazardous wastes less than 90 days. Has the issue of regulating all generators been considered since the improper storage, handling, treatment, or disposal of hazardous wastes may represent a sustained threat to health irrespective of the time factors involved?

3. On page S-19 of the DEIS it is estimated that 430,000 to 460,000 generators would have to comply with hazardous waste regulations. An indeterminant number of "special waste" generators could also have to comply. These figures are inconsistent with the statement noted on page 58946, column 3, of the December 18, 1978, Federal Register. That reference estimates approximately 270,000 waste generating facilities. This discrepancy should be resolved since the actual number of generators will have a drastic effect on the estimates of paperwork required under this regulation, numbers of generators affected, and the potential health and safety impact on the general population.

4. Using the figures in the Federal Register, it is estimated that approximately 270,000 waste generating facilities and 10,000 transporters will be regulated, although only about 30,000 of that number

will require treatment, storage, or disposal permits. Generators would be phased over a 5-year period with the larger producers brought into compliance first.

We do not agree with this philosophy and believe that through the application of the regulations to everyone, many generators can immediately be brought into "voluntary" compliance with little effort. It is recognized that some firms may require time extensions to achieve compliance, but this extension should be on a case-by-case basis.

We appreciate the difficulties associated with the development of regulations of this type and would be pleased to consult with you on the matters of concern to us if you so desire. We would like to receive six copies of the final statement when it is issued.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

0.4 The Utility Solid Waste Activities Group and the Edison Electric Institute

UTILITY SOLID WASTE ACTIVITIES GROUP
SUITE 401
1140 CONNECTICUT AVENUE, N.W.
WASHINGTON, D.C. 20036
(202) 862-3800

March 16, 1979

The Honorable Douglas M. Costle
Administrator
United States Environmental
  Protection Agency
401 M Street, S.W.
Washington, D. C. 20460

Re: Comments on Proposed Rules Under Sections 3001, 3002, 3003 and 3004 of the Resource Conservation and Recovery Act of 1976

Dear Mr. Administrator:

We are today submitting to your staff comments on the regulations proposed to implement Sections 3001-3004 of the Resource Conservation and Recovery Act of 1976 ("RCRA"). These comments have been prepared by and filed on behalf of the Utility Solid Waste Activities Group ("USWAG") and the Edison Electric Institute ("EEI"). USWAG is an informal consortium of approximately 65 utility operating companies and EEI.

You were gracious enough to meet with John J. Kearney, Senior Vice President of EEI, myself, our counsel and representatives of your staff on September 13, 1978 to discuss USWAG's concern with the scheduling, timing and overall implementation of RCRA. At that meeting, representatives of USWAG described the informational and technical problems which hasty implementation of RCRA would cause for generators of high volume electric utility waste. Among the points stressed to you was EPA's lack of adequate information about utilities. USWAG further offered to cooperate with EPA in every way possible to support a rational and economically feasible regulatory program consonant with the statute. Our comments submitted today reflect our good intentions.

Subsequent to our meeting, the United States District Court for the District of Columbia set a schedule for promulgation of RCRA regulations. EPA determined to close on March 16, 1979 the comment period for proposed regulations under Sections 3001-3004. By letter of February 27, 1979, at my request, USWAG's counsel sought an extension of time to submit USWAG's comments until at least 60 days after publication of proposed regulations under Sections 3005 and 3006. We have been informally advised that this request for additional time has been denied. 1/

We wish to stress to you USWAG's fundamental position that the vast majority of utility byproducts are not hazardous and thus are not subject to regulation under Subtitle C of RCRA. We believe that EPA has reached the conclusion that fly ash, bottom ash and sludge may cause damage to human health or the environment because of a misapprehension of the nature of these byproducts. EPA has candidly admitted that it possesses only extremely limited information on this subject at the present time. We believe that no basis presently exists for consideration of utility solid wastes under Subtitle C, and accordingly urge that EPA defer consideration of the entire matter to a later rulemaking. If any interim regulation is necessary at all, it is appropriate to impose only such minimal temporary requirements as accord with current utility practice. We believe that this approach allows your Agency to devote its resources to problems of major significance. Current utility disposal practices are sound, and existing information indicates that utility wastes do not pose any substantial threat to human health or the environment.

The comments submitted today are as complete and detailed as we could prepare in a limited time period. We hope that dialogue on a technical level can continue so that the full implications of the impact of RCRA on the utility industry may be understood and assessed. Finally, we ask that you, as Chairman of the Regulatory Council, consider the severe economic impact which these proposed regulations would have on our industry and the public.

We hope that our comments can assist your Agency in narrowing issues and bringing this important program into

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1/ We note that the March 12, 1979 Federal Register contained a notice of an extension of time for comments on a very limited part of the Section 3001 proposals.

focus. Representatives of USWAG stand ready to meet with you and your staff at any time.

Very truly yours,

Paul Emler Jr

Paul Emler, Jr.
Chairman, Policy Committee

cc: Mr. John P. Lehman, Director
Hazardous Waste Management Division
Office of Solid Waste
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D. C. 20460
(with 4 sets of comments)

Ms. Joan Z. Bernstein
General Counsel
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D. C. 20460
(with 1 set of comments)

Mr. Thomas C. Jorling
Assistant Administrator for Water and Waste Management
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401 M Street, S.W.
Washington, D. C. 20460
(with 1 set of comments)

Mr. Steffen W. Plehn
Deputy Assistant Administrator for Solid Waste
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401 M Street, S.W.
Washington, D. C. 20460
(with 1 set of comments)

COMMENTS ON PROPOSED RULES
UNDER SECTION 3001, 3002, 3003 and 3004
OF THE
RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

Submitted by

The Utility Solid Waste Activities Group

and

The Edison Electric Institute

to

The United States

Environmental Protection Agency

March 16, 1979

Volume III-A
Appendices

Of Counsel:

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Chairman, Policy Committee

Richard C. Clancy
Chairman, Steering/Audit Committee

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APPENDIX 7

CRITIQUE OF
THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON SUBTITLE C OF
THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

ENVIROSPHERE COMPANY
A DIVISION OF EBASCO SERVICES INCORPORATED
19 Rector Street
New York, New York
March 16, 1979

I. INTRODUCTION

This report presents Envirosphere Company's critique of the Draft Environmental Impact Statement (DEIS) prepared by the U.S. Environmental Protection Agency (EPA), and published as Background Document 33 to support proposed draft regulations pursuant to Subtitle C, Resource Conservation and Recovery Act of 1976 (RCRA). This critique has been prepared at the request of the Utility Solid Waste Activities Group (USWAG) as part of the overall USWAG effort to review all information pertinent to the current rulemaking in order to assess the impact of RCRA on the electric utility industry and its customers and to present responsible comments thereon.

Envirosphere Company is a division of Ebasco Services Incorporated. Ebasco is one of the world's leading engineering and construction companies, and has been in business for over 75 years. It is primarily engaged in the engineering and construction of power plants (nuclear, fossil and hydro). Envirosphere is the division of Ebasco responsible for providing environmental engineering and scientific consulting services to clients in both the private and public sectors. Envirosphere and its precursor, the Consulting Environmental Engineering Department of Ebasco, have provided such services to industry and government since the late 1960's. Envirosphere Company has had extensive experience with the Environmental Impact Statement process having prepared over 25 environmental reports associated with the licensing of industrial facilities entailing a combined capital investment of over twenty billion dollars.

The format of this report includes:

* a description of the scope of or criteria for the critique;
* a summary of the DEIS which describes the purpose of the DEIS, as presented therein, and briefly outlines its contents;
* a critique of the DEIS with respect to the criteria previously identified;
* a summary of conclusions regarding the value of the DEIS as support for EPA's proposed Subtitle C regulations.

II. SCOPE OF CRITIQUE

The critique of the DEIS has involved a number of different considerations. However, in its most basic sense, the critique has concentrated on assessing the factual support for and meaningfulness of the information in the DEIS and on examining the overall logic of the presentation. In effect, Envirosphere has attempted to determine the extent to which the DEIS does serve or can serve as effective support for EPA's proposed Subtitle C regulations.

The DEIS has also been examined in light of those typical requirements/standards for Environmental Impact Statements as required by Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA). In this regard, EPA's procedures with respect to voluntary Environmental Impact Statements for regulatory actions were reviewed. These procedures are set forth in the Federal Register, Vol. 39, No. 204, October 21, 1974; the EIS guidelines/contents requirements, as presented therein, are summarized in Exhibit 1.

The DEIS has also been examined, specifically, with respect to the attention given to the electric utility industry. In this regard, consideration was given to the extent to which EPA had knowledge of that industry; the validity of EPA's basic information; the impacts of the proposed regulations on the electric utility industry were assessed; and the validity of such assessments.

III. SUMMARY OF DEIS

The intent of the DEIS, as indicated in its Preface, is to present analyses of the proposed Subtitle C regulations as well as of alternatives to the proposed regulations which were considered.

The DEIS contents include:

- descriptions of the proposed action (namely, the RCRA Subtitle C regulations) and of related federal and state regulations and legislation;
- descriptions of the alternatives to the proposed action as well as of the rationale employed in selecting the alternatives;
- descriptions of the environmental and social impacts that would be expected for the proposed action and for each of the alternatives.

The DEIS considered four alternatives to the proposed action identified as follows:

* No Action
* Phasing of Generators
* Enhanced Public Health and Environmental Protection
* Lesser Degree of Public Health and Environmental Protection

Descriptions of each of these alternatives as well as of the rationale given for their selection are presented in Exhibit 2. For the proposed action and alternatives, the DEIS describes primary impacts (those directly attributable to the implementation of the regulations) and secondary impacts (those indirectly attributable). Primary impacts include consideration of such matters as administrative requirements; air impacts; water impacts; and public health impacts. Secondary impacts include consideration of matters such as physiography and soils impacts; biological impacts; social impacts; and hazardous wastes management facility capacity.

IV. CRITIQUE OF DEIS

Introduction

The review of the DEIS has resulted in the identification of several major limitations with respect to the DEIS. These limitations are identified below and are described in greater detail in the subsequent sections of this report.

A. Major DEIS Limitations

* The DEIS lacks quantitative estimates which measure

impact assessments in absolute terms.

- The impact assessments which are presented in the DEIS (almost exclusively qualitative) are based on an incomplete data base developed from available information for only certain manufacturing industries (not including the electric utility industry).
- The meaningfulness of the alternatives considered is believed questionable since there is no demonstration or support that they, in fact, reasonably consider the range (i.e., "bracket") of the resultant impacts that could result from the proposed or alternative strategies.
- The assessment of alternatives, each being considered as a combination of several regulatory options, does not permit the determination of the importance/ sensitivity of the effect or impact of each of the individual regulatory options which make up the whole of a particular alternative.
- The assessments of the alternatives to the proposed regulations are presented in qualitative and relative terms and do not allow for meaningful distinctions among and between the alternatives and the proposed action.
- The assessment of the alternatives, because of the underlying assumption that the degree of hazard is directly related to the volume of the waste, is of questionable value.

- There is no overall comparative assessment of the alternatives versus the proposed regulations which would present, from an overall perspective, the rationale for the selection of the proposed regulations.
- The DEIS addresses the electric utility industry and the impacts related to its o'eradions only minimally and openly confesses to a lack of information/knowledge with respect to this industry.

B. DEIS Lacks Quantitative Analyses

In its most basic sense, the objective of an environmental impact statement is to document meaningfully and describe the environmental impacts of the proposed action and alternatives. It is essential that the impacts be defined accurately and clearly in order to support reasonable and responsible decisionmaking. Moreover, in this connection, EPA's own procedure for Environmental Impact Statements for regulatory actions clearly state "Statements shall provide meaningful and factual data, information, and analyses."

In this most crucial aspect of an impact statement, the DEIS is seriously deficient because of the lack of quantitative and specific data and information, especially in key decision-making areas. Typically, when assessments are attempted in the DEIS, they are presented on a comparative, qualitative basis, presumably based on the judgment of EPA and their contractors. This absence of quantitative, absolute data and information effectively frustrates any attempt to distinguish clearly either absolute or incremental effects or impacts of the proposed or alternative actions.

Exhibit 3 presents numerous excerpts from the DEIS summary and Chapter 7 ("Impacts of the Proposed Action") which clearly demonstrate the qualitative nature of the impact assessments. As demonstrated by the excerpts presented in Exhibit 3, the impact assessments are replete with such terms as "should be significantly reduced"; "a large portion"; "an indeterminable number"; and "uncertainties exist."

The following are examples drawn from Exhibit 3 which further demonstrate this lack of specificity.

* In Excerpt 5, the DEIS addresses a "major impact" of the regulations, namely, the closing and/or modification of existing waste management facilities. Yet, other than indicating that a "large portion" of existing facilities would require modification, no estimates are presented as to numbers, locations, costs, or other relevant factors regarding closings and/or modifications.
* In Excerpt 9, in addressing improved air quality as a result of the regulations, the DEIS indicates that "for the most part," the regulations would lead to improvements in air quality. No estimates are provided of the extent of such improvements.
* In Excerpt 13, the DEIS indicates that the benefits of containerization which would "potentially"

decrease the number and size of spills would be counterbalanced by increased handling and transport that could result from a shift to off-site treatment or disposal. This type of statement does not provide much meaningful information with respect to the proposed regulations' improvement of the environment vis-a-vis spills of hazardous waste, or for that matter the environmental (or economic) consequence of increased disposal off-site.

* In Excerpt 14, the DEIS clearly confesses a lack of information on current groundwater contamination as well as on improvements that would result from the regulations. A statement of this nature is quite disturbing because the regulations require extensive expenditures of time and money to provide for groundwater monitoring and protection. Surely, there should be a more accurate understanding of the current situation and the anticipated improvements (for the proposed action as well as for the alternatives) before applying the regulations as proposed.

In summary, on this particular point, the DEIS does not nor does it purport to present specific, quantitative estimates of the impacts of the regulations and alternatives. The DEIS does present qualitative, subjective judgments which seem to be no more than conjecture unsupported by hard, factual information. This is hardly the kind of "meaningful and factual data, information, and analyses" concerning environmental impacts which could effectively aid the decision-maker in developing the RCRA Subtitle C regulations.

C. DEIS Is Based On An Incomplete And Limited Data Base

The previous comment noted that the impact assessments represented qualitative, subjective judgments and not quantitative estimates. The value and meaningfulness of these assessments are further weakened by the fact that they have been based on a limited data base representative of only the manufacturing industries. (Exhibit 4 presents excerpts from the DEIS which clearly outline the limitations in the data base used to support impact assessments.) The reasoning behind the selection of the manufacturing industries as the source of the data base was stated by EPA, as follows: "Because most available data relate to manufacturing industries, the emphasis of the impact analysis is necessarily directed toward manufacturing industries." In fact, the completeness of even that data base was called into question by EPA through the following statement:

> While every one of these manufacturing establishments is not likely to be a potential producer of hazardous wastes, the limited data preclude an accurate determination of the number that are . . . .

While there would seem to be ample justification to question the selection of the manufacutring industries data base as the basis for impact assessments in the DEIS, this comment relates not to the matter of data base selection, but to the inappropriateness of the DEIS subjective/qualitative judgments (based on manufacturing industry waste information) as applied to other industries' wastes. The differences in waste characteristics and treatment and disposal practices between industries and industrial groupings are extremely significant. This was recognized to a great extent by EPA in establishing the "special wastes" category.

Notwithstanding the special waste categorization, the proposed regulations do apply to and will have significant impacts on non-manufacturing industries. Yet, there has been no effort made to evaluate just what the impacts will be for these industries and whether or not the regulations are accordingly justified. This is a serious deficiency in the DEIS which significantly limits its usefulness to support decision-making.

D. Meaningfulness Of Alternatives

In choosing the alternatives to the proposed regulations, the approach taken in the DEIS, as stated by EPA, was "to select and to develop a manageable set of meaningful alternatives that reasonably bracket the overall objectives and the resultant impacts anticipated from whatever set of regulations are ultimately promulgated . . . ." We question the meaningfulness of EPA's alternatives selection on two accounts.

First, EPA does not provide any support or foundation to demonstrate that the alternatives that were selected actually do bracket the anticipated overall objectives and resultant impacts. We believe that such a demonstration by EPA is in order. Our basic contention in suggesting such a need is that unless the "world" that is to be affected (in this case, by the proposed or alternative regulations) is reasonably well known and defined, one cannot reasonably assume that the appropriate "bracket" has been established or that the resultant impacts have been bracketed. More specifically, and as reviewed previously, EPA has stated that the focus of its assessment has been with respect to manufacturing industries and that in many of these, the number of hazardous waste generators are not known. Alternatively stated, EPA has assessed the impacts of the regulations (i.e., proposed and alternatives) based on a "sample" of the "world" that will be impacted while it has demonstrated no support that its "sample" is representative.

If it were discovered that the "sample" used by EPA in its analysis was not representative, it is possible that the impacts such as plant closings or community out-migration could become extremely significant. Given that EPA has not quantified the absolute impacts of each of its alternatives nor quantified the incremental quantitative impacts among the alternatives and the proposed action, the reviewer has no reasonable way of accepting that the alternatives are meaningful ones which truly bracket the impacts from "whatever set of regulations that are ultimately promulgated . . . ."

Second, we question the meaningfulness of the alternatives since each alternative represents a combination of many different regulatory mechanisms and controls (see Exhibit 2 for a description of the alternatives). For example, the lesser degree of control alternative involves elimination of the identifying characteristics test of hazardousness, increasing the cutoff to 1000 kg/month, and other changes. Similarly, enhanced degree of control involves elimination of the special waste standards, no cutoff and expansion of the identifying characterisitcs applicability. Thus, when assessing the impact of an alternative, the DEIS is presenting the combined impact of a number of regulatory options. By this method of evaluation, the importance/significance of each of the regulatory options which make up a whole alternative is lost. For example, if 90 percent of the benefits accruing from the enhanced degree of control are achieved by eliminating the cutoff and very little benefit is achieved through expanding the identifying characterisitcs test (at probably considerable additional cost and inconvenience), these factors would be essential to the development of meaningful and cost effective regulations. The alternatives as they are presently structured do not allow for this type of regulatory option "sensitivity analysis."

The alternatives evaluation, in our opinion, should be structured so as to test the impact of each regulatory option, in and of itself. Thus, those options having real and significant benefits could be identified and included in the final regulations. Conversely, those options that have questionable or limited benefits but real and significant costs could be excluded.

E. Relative/Qualitative Nature Of Alternatives Assessment

As was the case for the impact assessment of the proposed regulations (see our comments in Section IV-B), the DEIS presents assessments of the impacts of the alternatives which are for the most part qualitative in nature and seriously deficient with respect to absolute/quantitative measures of impacts. Because the alternatives are assessed in such a qualitative/subjective fashion, the meaningfulness of the assessments cannot be determined and the overall value of the evaluation of alternatives is questionable.

The problem is further compounded by the fact that, in comparing an alternative to the proposed regulations, the comparison is carried out in relative terms. Thus, we are told that a particular alternative will have a "greater" or "lesser" impact than the proposed regulations without being told how much greater or how much lesser that impact will be. Further, we are given no indication of how significant or important this particular difference in impact is. When this is viewed in light of the fact that we have not been presented an assessment in quantitative terms of the impact of the proposed regulations -- to which we are comparing the alternative -- the value and credibility of the DEIS to support federal agency decision-making is open to significant doubt.

The following are excerpts drawn from the Summary of the DEIS which typify this method of impact assessment.

1. In comparing the no action alternative to the proposed regulations, it is stated (Summary, p. S-40) that "the overall control of hazardous

wastes would be much less effective . . ." than with the proposed regulations. How much is "much less effective" and just what would these impacts be? How significant are they?

2. Further, in comparing the no action alternative to the proposed regulations, it is stated (Summary, p. S-40) that "[i]n any state with significantly less stringent regulations than it would have under the Federal Program, there could be a significant increase in public health and environmental problems relative to those that would occur under Subtitle C regulations." What are the increases in public health and environmental problems? How significant are they? In which states might they occur?

3. In comparing the Phasing Alternative to the proposed regulations, it is stated (Summary, pp. S-42 and S-43) that "there would be an increased potential for the release of air, water, and soil contaminants." Just what the increases might be is not stated.

4. Further, in comparing the Phasing Alternative to the proposed regulations, it is stated (Summary, p. S-43) that "[t]o the extent that increased releases were to

occur, there would be an increased potential for the occurrence of adverse public health and environmental impacts." First, the extent to which there would be increased releases of air, water, and soil contaminants has not been defined. Second, the extent and significance of increased occurrences of adverse public health and environmental impacts are not presented.

5. In comparing the Enhanced Public Health and Environmental Protection Alternative to the proposed regulations, it is stated that "[t]he regulations under this alternative would have the potential to cause further changes, primarily reductions, in the release of air emissions and water effluents from the generation, transport, storage, treatment and disposal of hazardous wastes, as compared to the proposed regulations." Estimates of the extent and significance of such changes -- which are purported primarily to be reductions -- are not presented.

6. Further, in comparing the Enhanced Public Health and Environmental Protection Alternative to the proposed regulations, it is

stated (Summary, p. S-49) that "[t]he regulations under this alternative would have the potential for further increasing the public health benefits to be derived from the control of hazardous wastes. The regulations would reduce the potential for the release of air, water, and soil contaminants from hazardous waste management and, thus, for resultant public health impacts." The extent and significance of such reductions are not presented.

F. DEIS Assumes Direct Relationship Between Waste Volume And Impact

In comparing the impacts of the proposed regulations to those of the alternatives and, in fact, in assessing the impacts of the alternatives, EPA's asessments often contained an underlying assumption that degree of hazardousness was directly related to waste volume. This is obviously an incorrect assumption; one, in fact, to which EPA would certainly not subscribe. However, as a result of a lack of information and a lack of other available assessment means, EPA often assessed the alternatives in terms of the volumes of wastes generated. As a result of the inclusion of this incorrect assumption, the results of EPA's analysis could be extremely misleading.

This point can best be demonstrated by the example of the assessment of the phasing alternative. The phasing alternative consisted of increasing the volume of waste under control at a rate of 20 percent per year, resulting in all wastes being subjected to control after an initial five year period. In assessing this particular alternative, EPA's analysis was directed at the volume of waste under control without giving consideration to the threat to public health, welfare and the environment inherent in the waste, regardless of volume.

Specifically, a "straight line" type of approach is implied in the analyses. That is, if 20 percent of the total wastes is managed, then 20 percent of the ultimate benefit is achieved at 20 percent of the cost. This is obviously an overly simplistic approach and, indeed, may well ignore reality. For example, management of relatively small wastes could yield far greater proportionate benefits if such wastes had high risks or high potential for environmental harm. Ultimately, it may be possible to control less than that amount of wastes currently expected by EPA with far less dislocation and greater benefit.

We suggest that a more meaningful approach to analyzing this alternative would entail focusing on "threat" or "risk" potential of wastes and the step-wise management of those posing the greatest risk/threat first and the least risk/threat last. In the analysis of such an approach, the benefits/disadvantages that may accrue to society by allowing monitoring of the results (i.e., actual cost/benefit) at the end of years one through "n" could be assessed and allow for "re-focus" of the regulations as a function of time.

G. Lack of Overall/Comparative Assessment Of Alternatives

The DEIS describes the proposed regulations and four alternative sets of regulations (see Exhibit 2 for description of the alternatives). It presents an impact assessment (albeit qualitative) for the proposed regulations and individual assessments for each alternative relative to the proposed regulations. There is, however, no overall/comparative assessment indicating, all things considered, how the proposed regulations and the alternatives "stack up" one against the other. This is in direct contradiction to the EPA guidelines for impact statements on regulatory actions (see Exhibit 1) which require that "the reasons why the proposed action is believed by the Agency to re dhuobuctocourse of action shall be explained."

Obviously, EPA has decided that the proposed regulations, in an overall sense, are preferred as compared to each of the alternatives. However, the rationale for why the proposed regulations are preferred is not presented. Each of the alternatives and the proposed regulations are compared in specific areas. That is, the phasing alternative may require less paperwork than the proposed regulations and from that standpoint is preferred. Similarly, the lesser degree of control alternative will result in greater emissions of air, water and soil contaminants and from that standpoint may be inferior to the proposed regulations. What is lacking, however, is an analysis combining the positive and negative aspects of each of the alternatives in comparison to the proposed regulations and demonstrating the overall desirability of the proposed regulations.

We feel that such an overall/comparative assessment considering economic, social and environmental costs and benefits is required. Since the DEIS does not include economic cost estimates (this information is supposedly included in the Economic Impact Analysis which is referenced), the least that the DEIS could do is to present an analysis from the standpoint of the environmental and social considerations which have been addressed. As it currently stands, we feel that the document is inconclusive and does not present EPA's reasoning for its selection of the proposed regulations.

H. Lack Of An Impact Assessment With Respect To Utility Industry Wastes

The DEIS does not include nor does it purport to include an impact assesment of the proposed regulations with respect to utility industry wastes whether these wastes be high volume wastes and included in the special wastes category or otherwise. The draft impact statement does point out that certain utility wastes, because of unique characteristics, have been included in the "special wastes" category wherein (provided they are found to be hazardous under an identifying characteristics test of Section 3001), they would only be subject to some of the Subpart D requirements. No impact assessment is, however, presented with respect to the impact of even those limited requirements on the electric utility industry wastes which fall under the special waste category. Moreover, no assessment is presented with respect to the impact of the entire set of regulations on all other utility wastes which are not included in the special wastes category.

Specifically, by way of example, the DEIS does not address:

- the impact of the "regulatory floodway," "coastal high hazard area," "500 year floodplain," etc. exclusion criteria;
- the impact of the "security," "manifesting" or "visual" inspections requirements;
- the need for or impact of the "closure" and "post-closure" care requirements on the electric utility industry;
- the basis for or the impact of requiring groundwater monitoring at utility industry power plants.

With respect to the electric utility industry -- its operations and resulting wastes -- the impact statement evidences a significant lack of information and knowledge.

In fact, this lack of information/knowledge is often presented as the reasoning behind not giving a fuller appraisal of the impact of the regulations on this industry and its wastes. This admitted lack of information/knowledge, at the same time, serves to undercut very significantly the meaningfulness and the basis of EPA's proposed regulations as they apply to the electric utility industry.

Exhibit 5 presents excerpts from the DEIS wherein the electric utility industry or the special wastes category are mentioned. It clearly demonstrates that only minimal/ insubstantial attention has been given this most significant industry which could be considerably affected by the regulations. In this regard, the following points should be noted:

Notwithstanding an admitted lack of information on the electric utility industry and its wastes, the DEIS refers in numerous instances to wastes resulting from the combustion of coal as "potentially hazardous" (see Excerpts 15, 16, 17 and 20 of Exhibit 5). In reality, in accord with the regulations, every waste is potentially hazardous until a specific determination based on the Section 3001 testing procedures is made. Identification, at this stage, of a particular waste as being potentially hazardous (without any knowledge of whether or not it will be determined to be hazardous or, if so, to what extent), is patently irresponsible. Industries whose wastes have been identified and characterized as such could suffer serious consequences purely from such a characterization.

Clearly, because of the obvious implications, it is incumbent upon EPA to refrain from giving inappropriate and damaging "labels" to wastes when, in fact, it is acting without factual data and information.

Excerpt 23 (Exhibit 5) refers to a table in the DEIS which lists 57 cases of groundwater contamination caused by leakage of wastewater from surface impoundments. One of these 57 cases is reported as iron and manganese pollution from an electric utility industry source. However, no detail or further information is given on the impact, if any, on public health or the environment. Moreover, in referring to this particular table in the DEIS, EPA refers to the table as presenting incidents of groundwater contamination due to hazardous waste disposal. This is obviously in conflict with the title of the table, "Origins and Pollutants in 57 Cases of Ground Water Contamination in the Northeast Caused by Leakage of Waste Water from Surface Impoundments," and certainly, without presenting any further information, seems to be a rather careless use of the characterization "hazardous." At a broader level, the DEIS has not considered recovery and utilization potential of utility industry wastes or the extent to which such potential may be foregone by the proposed regulations. (A complete discussion of reuse and recovery is included in these comments in the appendix entitled "Summary Report on Large Volume Electric Utility Industry Solid Wastes as a Resource For Recovery and Utilization.") In a similar vein, the DEIS has not considered the impact of the regulations, vis-a-vis reduced coal consumption, on U.S. plans to develop our coal reserves extensively in order to achieve energy independence.

CONCLUSION

Because of all of the limitations discussed in Chapter 4, but primarily because of the lack of meaningful and factual data, information and analyses regarding the environental impacts of the proposed action and alternatives, we conclude that the DEIS provides little credible support for the proposed Subtitle C regulations. For the most part, information presented in the DEIS is qualitative and conjectural in nature and unsupported by hard, factual information. It does not provide credible support for the development and/or adoption of the specific regulations which have been proposed.

With respect to the electric utility industry, the DEIS does not present, nor does it purport to present, an analysis of the impacts of the proposed regulations. In fact, the DEIS often times points out the inadequacies in the data and information available to characterize electric utility industry operating practices and wastes. Consequently, because of the repeated admissions regarding the limited knowledge and information of the electric utility industry, the DEIS, rather than provide support for the regulations, actually undermines their applicability to this particular industry.

EXHIBIT I

SUMMARY OF EPA'S GUIDELINES
FOR THE CONTENT OF
ENVIRONMENTAL IMPACT STATEMENTS
FOR REGULATORY ACTIONS

The following represents summarizations and excerpts from EPA's guidelines (Federal Register, Vol. 39, No. 204, October 21, 1974) for the content of Environmental Impact Statements for regulatory actions.

BODY OF STATEMENT

"The body of the impact statement shall include the material discussed in the several sections below."

"Impact statements shall not be justification documents for proposed Agency actions. Rather, they shall be objective evaluations of actions and their alternatives in light of all environmental considerations."

"Statements shall provide meaningful and factual data, information, and analyses."

"The presentation should be simple and concise, yet include those facts necessary to permit an evaluation and appraisal of the beneficial and adverse environmental effects of alternative actions."

EXHIBIT 1 (Continued)

(1) Background and Description of Proposed Action

This section should present descriptions of the proposed action, its purpose and its relationship to other actions significantly affected by the proposd action.

(2) Alternatives to the Proposed Action

This section should present a description and evaluation of the reasonable alternatives to the proposed action.

"The analysis should be sufficiently detailed to reveal the Agency's comparative evaluation of the beneficial and adverse environmental, health, social, and economic effects of the proposed action and each reasonable alternative, including the identification of the uncertainties associated with the evaluation."

"This analysis shall evaluate alternatives in such a manner that reviewers can judge their relative desirability. In addition, the reasons why the proposed action is believed by the Agency to be the best course of action shall be explained."

(3) Environmental Impact of the Proposed Action

This section should present a description of the primary and secondary impacts, both beneficial and adverse, anticipated from the action.

EXHIBIT 1 (Continued)

"(A) Primary impacts are those that can be attributed directly to the action, such as reduced levels of specific pollutants brought about by a new standard and the physical changes that occur in the various media with this reduction.

"(B) Secondary impacts are indirect or induced impacts."

(4) Other Considerations

This section should include descriptions of:

"(A) Adverse impacts which cannot be avoided should the proposal be implemented."

"(B) Relationship between local short term uses of man's environment and the maintenance and enhancement of long term productivity."

"(C) Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."

"(D) A discussion of problems and objections raised by other Federal, State, and local agencies and by other persons in this review process."

EXHIBIT 2

DESCRIPTION OF ALTERNATIVES
CONSIDERED IN THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT

The DEIS involved consideration of four alternatives to the proposed Subtitle C regulations. The alternatives were selected purportedly because they "reasonably bracket the overall objectives and the resultant impacts anticipated from whatever set of regulations are ultimately promulgated under Subtitle C. With this approach it is possible to show the range and types of potential impacts that could result under various alternatives without having to explicitly consider the most infinite variety of options for accomplishing the same or intermediate objectives." The alternatives selected by EPA and considered in the DEIS are as follows:

No Action - assumes no part of RCRA to be implemented and that hazardous waste management would continue as currently practiced.

Phasing of Generators - involves increasing the quantity of wastes controlled during the first five years following promulgation of the regulations by gradually expanding the number of generators brought under control. The generator limit is to be reduced so that equal amounts of hazardous wastes are annually brought under the program's control over the five-year period, *i.e.*,

EXHIBIT 2 (Continued)

20 percent of the total industrial hazardous waste per year.

Enhanced Public Health and Environmental Protection - involves expanding the definition of hazardous waste "in order to bring additional wastes under control of the program; to remove exclusions provided for hazardous waste generators; to apply more stringent design and operational requirements for storers, treaters, and disposers; to eliminate the special standards for 'special wastes'; to reduce reporting intervals for storers, treaters, and disposers; to eliminate the use of delivery documents in lieu of manifests; and to decrease the life of permits and impose additional restrictions on obtaining permits."
Lesser Degree of Public Health and Environmental Protection - involves modifying the definition of hazart uc gacduco"in order to bring fewer wastes under the control of the program; to increase exclusions provided for hazardous waste generators; to reduce manifest requirements; to apply less stringent design and operational requirements for storers, treaters, and disposers; to eliminate regulations of 'special wastes'; to decrease record keeping times . . . ; to increase the length of permit

EXHIBIT 2 (Continued)

exclusions for generators who store prior to off-site disposal; to eliminate restrictions on interim authorization; and to ease restrictions on full and partial authorization."

EXHIBIT 3

DEIS EXCERPTS DEMONSTRATING QUALITATIVE NATURE OF IMPACT ASSESSMENT

(1) Page S-12 - "The impact analysis is both generic in scope and conducted on a national level due to the extreme waste-specific, process-specific, and site-specific nature of most impacts, and due to the data limitations noted in the text."

(2) Page S-15 - "In addition, since one major result of the regulations would be to increase hazardous waste generation, storage, treatment, and disposal costs, generators would have an incentive to modify processes so as to reduce and/or change the types and amounts of hazardous wastes generated, and to enable the increased recycling of hazardous wastes as process feedstocks."

(3) Page S-15 - "There are numerous reported instances of hazardous waste transporters dumping wastes surreptitiously, rather than delivering the wastes to an environmentally acceptable storage, treatment, or disposal facility. The manifest and reporting requirements should significantly reduce, if not eliminate, such practices."

(49 Pages C-15 and 16 - "[T]he regulations would impose requirements that all transportation-related spills of hazardous wastes be reported immediately and be cleaned up by the transporter. Requirements for accepting, loading, and stowing hazardous waste shipments would potentially lead to fewer accidents and spills from hazardous waste transport. However, the average distance over which hazardous wastes are transported would likely increase as a result of the regulations. Increased transport distances would increase the potential for vehicular accidents. Increased transport distances would also increase the potential for spills, and this could offset some of the benefits indicated above."

(5) Page S-16 - "A major impact resulting from the Subtitle C regulations would be the closing of those hazardous waste management facilities (both off-site and on-site) that could not or would not comply with the storage, treatment, or disposal requirements. It would also lead to the modification of other hazardous waste management facilities to enable compliance. It is expected that a large portion of existing facilities would require modification in order to comply with the regulations."

(6) Page S-18 - "The Subtitle C regulations would likely lead to changes in the portion of hazardous wastes treated/disposed on-site by generators and off-site by the waste management industry. For reasons discussed in Chapter 7, it is not possible to accurately determine the extent of any shift that could occur under the Subtitle C regulations.

(7) Page S-19 - "An indeterminable number of other storers, treaters, and disposers could also be required to obtain permits."

(8) Page S-20 - "An indeterminable number of transporters and other potential generators and permittees would also have to file such notifications (under Section 3010)."

(9) Page S-21 - "For the most part, the regulations would lead to reduction in the release of air contaminants and to resultant improvements in air quality."

(10) Page S-23 - "The Subtitle C regulations contain requirements that should reduce the potential for fugitive emissions from the land-based treatment/disposal of hazardous wastes."

(11) Page S-25 - "The Subtitle C regulations contain provisions that should reduce the potential for fugitive emissions from other hazardous waste treatment facilities (e.g., biological, physical, and chemical treatment facilities)."

(12) Page S-26 - "It should be noted, however, that there would likely be some shift in the types of methods used to store, treat, or dispose these additional wastes under the regulations as compared to the unregulated current practices. . . . Such shifts could, to an indeterminable extent, either enhance or reduce the potential for indicated reductions in specific air emissions."

(13) Page S-27 - "The Subtitle C regulations would potentially result in a small decrease in the number and site of spills of hazardous wastes, primarily through containerization requirements. However, any shift to off-site treatment or disposal would necessitate more handling and farther

EXHIBIT 3 (Continued)

transportation distances, and could tend to offset some of the potential for a decrease in hazardous spills."

(14) Page S-28 - "Since there are no estimates of the extent of existing groundwater contamination due to hazardous wastes, it is not possible to quantify the improvements that would result from the regulations."

(15) Page S-28 - "It should be noted, however, that there could be shifts in the types of methods used to treat/dispose the wastes brought under regulation by this alternative. As previously discussed, such shifts could result in localized changes in the release of specific water contaminants and, thus, could result in localized changes in water quality."

(16) Page S-31 - "Although the impact of the regulations cannot be quantified, many of the types of incidents of contamination and associated biological effects which have been observed in the past would be prevented by promulgation of the regulations."

(17) Page S-32 - "Demographic Impacts. Promulgation of the Subtitle C regulations would likely cause some plant closings and job losses in a few segments of some industrial categories (e.g., textile industry, inorganic chemicals industry, organic chemicals industry, metals smelting and refining industry, electroplating and metal finishing industry). Such plant closings and job losses would have the potential to cause relocations of some of the affected workers and their families. There would be a potential for some out-migrations from communities or areas for which plants being closed constituted the primary source of employment."

(18) Page S-35 - "It is estimated that there would potentially be sufficient process capacity to manage hazardous industrial wastes shipped off-site in 1980. In the case of 13 percent off-site shipment, there would potentially be sufficient process capacity to manage hazardous industrial wastes shipped off-site in 1984. In the case of 25 percent off-site shipment, there would potentially be a shortfall of 2.6 million metric tons of environmentally adequate off-site capacity for treating/disposing hazardous industrial wastes in 1984.

Approximately 45 additional off-site facilities could be required by 1984. Data are not available to estimate if there would be any potential shortfall in environmentally adequate, on-site, hazardous waste management process capacity under the Subtitle C regulations."

(19) Page S-37 - "Since one of the major impacts of the regulations would be to increase generator's costs and the costs associated with hazardous waste transport, storage, treatment, and disposal, there would be an incentive provided by the regulations for generators to modify processes so as to enable increased recycling of hazardous wastes as process feedstocks, to reduce the quantities of hazardous wastes generated by specific processes, or to alter the nature of the wastes generated by treatment. Any changes would be extremely waste stream and process-specific. Furthermore, since the regulations prohibit the placing of ignitable wastes in landfills, landfarms, surface impoundments, and basins, the potential for increased incineration of such wastes, with possible energy recovery, would be greatly enhanced."

(20) Page 7-1 - "The impact analysis is, for the most part, both generic in scope and conducted on a national level due to the extreme waste-specific, process-specific, and site-specific nature of most impacts, and due to the extensive data limitations previously indicated."

(21) Pages 7-16 & 17 - "As discussed in Section 5.4, the potential for process modifications to promote resource conservation and/or recovery would be extremely waste stream and process-specific and would depend upon such factors as the economics of disposal, treatment, and transport; the cost of raw materials and energy; the availability of markets for and sources of recyclable hazardous wastes; and the availability both of the necessary technology for specific resource conservation or recovery applications and of environmentally adequate disposal methods. Due to the many complex interrelationships among these factors, the determination of specific process modifications and resultant changes to waste streams that could occur as a result of promulgation of the Subtitle C regulations is beyond the scope of the EIS."

EXHIBIT 3 (Continued)

(22) Page 7-27 - "Data are not available to estimate the number and type of hazardous waste treatment/disposal facilities that would have to close down or be modified as a result of the proposed regulations. However, based on the reported incidences in Appendix J and other available data discussed below, it is expected that a very large portion of existing facilities would require modification to be able to comply with treatment/disposal requirements."

(23) Page 7-37 - "It should be noted that these data are being used as a surrogate to analyze potential impacts that could occur from a shift in on-site and off-site disposal, should such a shift occur, and not as a firm estimate of the magnitude of any such shift."

(24) Page 7-183 - "As indicated in the Integrated Economic Impact Assessment of Hazardous Waste Management Regulations (Regulatory Analysis Supplement), promulgation of the Subtitle C regulations would likely cause some plant closings and job losses in a number of industrial segments (e.g., textile industry, inorganic chemicals industry, organic chemicals industry, metals smelting and refining industry, electroplating and metal finishing industry). Such plant closings and job losses would have the potential to cause relocations of some of the affected workers and their families. The nature and extent of any such relocations and population shifts would be site-specific and dependent upon such factors as number of workers affected, local and national skills, age of affected workers, and willingness of workers to relocate. There would be a potential for large-scale out-migrations from any communities or areas for which plants being closed constituted the primary source of employment."

(25) Pages 7-212 & 213 - "Significant Uncertainties in the Impact Analysis. The impact analysis is subject to a number of significant uncertainties. Limited data are currently available with regard to both the generation and the management of hazardous wastes. Uncertainties exist as to the types and quantities of hazardous wastes generated by various sources, especially nonmanufacturing sources. Uncertainties also exist as to the number, distribution, capacity, and adequacy of existing hazardous

EXHIBIT 3 (Continued)

waste management facilities. Data are sparse on the generation and release of specific hazardous air, water, and soil contaminants by various storage, treatment, and disposal methods. Data and methodologies are not available, for the most part, for determining the movement, transformation, and ultimate fate of most contaminants released to the environment. Human and biological health effects which are a function of both the concentrations of such contaminants and the duration of exposure are, therefore, uncertain. Dose-response data are not yet established for determining health effects from many potentially hazardous contaminants. These limited data, coupled with the site, process, and waste-specific nature of most impacts, necessitates a qualitative assessment."

EXHIBIT 4

EXCERPTS FROM DEIS DEMONSTRATING LIMITATIONS IN DATA BASE

(1) Pages S-12 & 7-1 - "Because most available data relate to manufacturing industries, the emphasis of the impact analysis is necessarily directed toward manufacturing industries."

(2) Pages S-13 & 14 - "In addition to manufacturing wastes, an indeterminate portion of other large volume wastes, such as waste automotive oil, coal ash, oil drilling muds and brines, cement kiln dusts, phosphate mining and processing wastes, and uranium mining wastes, could be more substantially controlled under the regulations."

(3) Page S-19 - "An indeterminable number of other potential generators (*e.g.*, special waste generators) could also have to comply [with the generator regulations]."

(4) Page S-19 - "An indeterminable number of other storers, treaters, and disposers could also be required to obtain permits."

(5) Page 7-9 - "The identifying characteristics could result in the regulation of such other large volume wastes as waste automotive oil, coal ash, oil drilling muds and brines, cement kiln dusts, and dredge spoils. Estimates of the annual production of these wastes are presented in Chapter 6. The portion of such wastes that could be identified as hazardous by the characteristics is not known."

(6) Page 7-45 - "While every one of these manufacturing establishments is not likely to be a potential producer of hazardous wastes, the limited data available preclude an accurate determination of the number that are."

(7) Page 7-51 - "Data are not available to estimate the number of potential producers of other hazardous 'special wastes'; however, the number could be large. For example, 10,000 to 20,000 oil wells have been drilled annually in recent years with about 60 percent of these wells being successful (U.S. Department of the Interior, 1976); however, the number of currently producing wells generating potentially hazardous brines and muds is not known."

(8) Pages 7-52 & 53 - "According to a recent study of the hazardous waste transport industry (Arthur D. Little, 1978), the number of firms currently transporting hazardous wastes is unknown, both for the industry as a whole and for each of its segments."

(9) Page 7-53 - "A study by Battelle Columbus Laboratories (1978) attempted to estimate the number of potential permittees under the regulations. Table 7-7 shows the Battelle Columbus Laboratories' estimate of the number of potential permittees for the manufacturing industries (listed in Table 7-5), Federal installations, hospitals, automotive service stations, and the existing hazardous wastes management service industry. There are estimated to be about 29,000 potential permittees within these groups. According to that study, data are not available to estimate the number of potential permittees within other categories."

(10) Page 7-193 - "A recent study of the hazardous waste management service industry (Foster D. Snell, Inc., 1976) indicated that at the end of 1974, the process capacity for the industry as a whole was nearly 7.3 million metric tons per year, with up to approximately 5.3 million metric tons being considered environmentally adequate. It should be noted that all capacity considered environmentally adequate by the Foster D. Snell Study may not be considered environmentally adequate under Subtitle C. Thus, the Foster D. Snell numbers should be viewed only as an upper limit on environmentally adequate capacity."

(11) Page 7-197 - "As indicated in Section 7.1.2.4, the Subtitle C regulations would likely result in the indeterminable decrease in existing on-site process capcity and, as a result, could potentially cause shortfalls in on-site process capacity in both 1980 and 1984."

(12) Page 7-212 - "Limited data are currently available with regard to both the generation and the management of hazardous wastes."

(13) Page 7-213 - "The emphasis of the impact analysis has necessarily been placed on hazardous manufacturing wastes, though large volume of some other hazardous wastes may also be generated."

EXHIBIT 5

LISTING OF DEIS CITATIONS

RELATING TO

THE ELECTRIC UTILITY INDUSTRY

1. In the Summary of the DEIS (p. S-4), in describing the Section 3004 regulations, it is stated that "the Section 3004 regulations establish standards. . . for management of "special wastes" (i.e., . . . utility wastes . . .)".

2. In the Summary (p. S-10) and in Chapter 4 - Identification and Selection of Feasible Alternatives (pp. 4-10 and 4-11), in describing the Enhanced Public Health and Environmental Protection Alternative, it is stated that this alternative would "eliminate the special standards for special wastes. . . ."

3. In the Summary (pp. S-10 and S-11) and in Chapter 4 (pp. 4-19), in describing the Lesser Degree of Public Health and Environmental Protection Alternative, it is stated that this alternative would "eliminate regulation of special wastes. . . ."

4. In the Summary (pp. S-13 and S-14), in describing the hazardous wastes to be regulated by the proposed regulations, it is stated that "in addition to manufacturing wastes, an indeterminate portion of other large volume wastes, such as . . . coal ash . . ., could be more substantially controlled under the regulations . . . ."

5. In the Summary (p. S-19), in describing the number of generators required to comply with the regulations, it is stated that "an indeterminable number of other potential generators (*e.g.*, 'special waste' generators) could also have to comply. . . ."

6. In the Summary (pp. S-43, S-44 and S-45), in describing the hazardous wastes to be regulated under the Enhanced Public Health and Environmental Protection Alternative as compared to the proposed regulations, it is stated that "there would also be an indeterminable, but possibly quite large, increase in hazardous non-manufacturing wastes regulated under this alternative. . . ."

7. In the Summary (p. S-53), in describing the hazardous wastes to be regulated under the Lesser Degree of Public Health and Environmental Protection Alternative as compared to the proposed regulations, it is stated that "there would also be an indeterminable, but possibly quite large, decrease in hazardous non-manufacturing wastes regulated under this alternative. . . ."

8. In Chapter 1 - Introduction (pp. 1-2), in describing the proposed regulations, it is stated that "in the event of major changes to the regulations presented herein, and/or in the event of additional regulations affecting large

volume special wastes (i.e., utility wastes . . .) a supplemental Environmental Impact Statement would be prepared. . . ."

9. In Chapter 3 - Description of the Proposed Action (pp. 3-7), in describing the Section 3004 regulations, it is stated that "all owners and operators of facilities that treat, store or dispose 'special wastes,' and no other hazardous waste, would have to comply only with the general facility standards. . . ." See also Chapter 7 (pp. 7-23 and 7-25) for similar statements.

10. In Chapter 3 (pp. 3-10 and 3-11), the description of the special wastes categorization is presented as follows: "[S]everal waste streams have been identified as being of special concern due to their unique characteristics, and the techno-economic uncertainties regarding their disposal. These 'special wastes' are high volume wastes which are often disposed on-site by generators, for which traditional land disposal technology is techno-economically inappropriate, and whose environmental risk is ill-defined. These 'special waste' streams include: utility wastes (fly ash, bottom ash), oil drilling muds and brines, cement kiln dusts, phosphate rock mining and processing wastes, uranium mining wastes, and other mining wastes. In the event these wastes meet a hazardous characteristic or are listed, unique facility standards will be developed for

them. However, these wastes would presently be subject only to general standards for record keeping, reporting, etc. EPA intends to develop control technology standards for these wastes as soon as possible."

11. In Chapter 4 (pp. 4-25), in describing the Lesser Degree of Public Health and Environmental Protection Alternative, it is stated that "under this alternative, the definition of hazardous wastes in Section 3001 has been modified to include fewer wastes by eliminating the characteristic for toxic wastes; listed wastes whose listing is based solely on the toxicity characteristics (including those listed based on the Administrator's judgment) have been removed from the Section 3001 lists. Special wastes, (e.g., cement kiln dust wastes and utility wastes) have been specifically excluded from being identified as hazardous wastes under Section 3001."

12. In Chapter 4 (pp. 4-36), in describing the Lesser Degree of Public Health and Environmental Protection Alternative, it is stated that "regulations of 'special wastes' under Section 3004 has been eliminated. . . . ."

13. In Chapter 5 - Existing Hazards Waste Generation and Management Practices (p. 5-19), in describing end use activities which result in the generation of hazardous

wastes, it is stated that "end use generators of potentially hazardous wastes include . . . utilities . . . ." It is further stated (p. 5-20) that "end use activities which consume part or all of a product may produce residual materials which are potentially hazardous. For example, coal-fired power plants generate coal ash which may be a potentially hazardous waste, depending on its constituents. . . ."

14. In Chapter 5 (p. 5-73), in discussing the paucity of formalized programs encouraging resource recovery, it is stated that "The National Ash Association, for example, has a formalized program and has estimated that ash recycling has risen to 20 percent from 12.3 percent in a recent 10-year period (National Ash Association, 1977)."

15. In Chapter 6 - Quantities of Hazardous Wastes Generated and Controlled (pp. 6-4 and 6-50), in describing those other sources of potential hazardous wastes, in addition to the manufacturing industries, it is stated that "these include non-industrial waste oils, hospital wastes, agricultural wastes, household wastes, military wastes, flyash, oil well brines and muds, cement kiln dusts, dredge spoils, and phosphate slimes. . . ." The degree of hazard associated with the above mentioned wastes varies considerably, both among and within the different categories.

Data on the amounts of waste generated and on the fractions of the total which are associated with a particular degree of hazard are incomplete. . . ."

16. In Chapter 6 (p. 6-6), Table 6-2 entitled "Estimated Annual Generation of Potentially Hazardous Non-Manufacturing Wastes" lists coal ash wastes of 54 million metric tons (composed of 38, 12 and 4 million metric tons, respectively, of fly ash, bottom ash and boiler slag).

17. In Chapter 6 (pp. 6-8), in providing available estimates of potentially hazardous waste generated from fly ash, it is stated that "estimates of the 1975 U.S. coal ash production are on the order of 38 million metric tons fly ash, 12 million metric tons of bottom ash, and 4.2 million metric tons of boiler slag (Faber, 1976). Of these amounts, about 8.9 million metric tons (16.3 percent) were utilized in secondary products, primarily in . . . cement and concrete, and in the manufacture of light-weight aggregates (Faber, 1976). The inclusion of many of the potentially toxic trace elements and other constituents (e.g. complex organic compounds) originally contained in the coal may result in the designation of at least some ash as hazardous."

18. In Chapter 7 - Impacts of the Proposed Action (pp. 7-2, 7-3, and 7-4), in describing the extent to which special wastes are considered in the impact analysis, it is stated that "it should be noted that a potentially large category of hazardous wastes, termed 'special wastes,' are only briefly addressed in the impact analysis. 'Special Wastes' include cement kiln dusts, utility wastes, oil drilling muds/brines, phosphate rock mining and processing wastes, uranium mining wastes, and other mining wastes. Any 'special wastes' identified as hazardous under the Subtitle C regulations would be subject to a limited portion of Subtitle C storage, treatment, and disposal regulations (see Sections 7.1.2.3 and 7.1.2.4). As a result, it is not likely that there would be any significant change in the current storage, treatment or disposal practices for such wastes. EPA is presently planning to promulgate specific Subtitle C requirements for the management of much of these 'special wastes.' An additional environment impact statement or supplementary statement would be prepared for these 'special wastes,' if warranted, at such time."

19. In Chapter 7 (p. 7-9), in describing the hazardous wastes to be regulated, the following statment is made: "The

identifying characteristics could result in the regulation of such other large volume wastes as waste automotive oil, coal ash, oil drilling muds and brines, cement kiln dusts, and dredge spoils. Estimates of the annual production of these wastes are presented in Chapter 6. The portion of such wastes that could be identified as hazardous by the characteristics is not known."

20. In Chapter 7 (p. 7-50), Table 7-6 lists the number of storers, potential producers of hazardous wastes to include 250-275 coal-fired utilities.

21. In Chapter 7 (p. 7-53), in discussing the number of treaters and disposers of 'special wastes,' it is stated that "there could be potentially a large number of permittees. For example, in Wyoming alone there are about 10,000 lagoons used for the disposal of oil drilling muds and brines. Data are not available to estimate the portion of 'special wastes' that would be identified as hazardous, nor the number of potential permittees managing such hazardous 'special wastes.'"

22. In Chapter 7 (p. 7-57), in addressing the number of annual reports by generators of hazardous wastes, it is stated that "an indeterminable number of additional annual reports

would also have to be prepared by other generators and hazardous waste management facilities such as generators or disposers of 'special wastes.'"

23. In Chapter 7 (pp. 7-128 and 7-129), Table 7-10 entitled "Origins and Pollutants in 57 cases of Ground Water Contamination in the Northeast caused by Leakage of Waste Water from Surface Impoundments" includes one case of reported pollution from iron and manganese identified by industry as "electric utility."

0.5 Mobil Oil Corporation

Mobil Oil Corporation

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D.P. HEATH
MANAGER
ENVIRONMENTAL AFFAIRS

March 16, 1979

Postmarked
3/16/79

REGISTERED - RETURN RECEIPT

Mr. John P. Lehman
Director, Hazardous Waste
Management Division
Office of Solid Waste (WH-565)
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

PROPOSED HAZARDOUS WASTE
GUIDELINES AND REGULATIONS
42 FR 58946 - 59022

Dear Mr. Lehman:

This letter and attachments present our comments on EPA's proposed Hazardous Waste Guidelines and Regulations as published in the Federal Register December 18, 1978.

We support the basic concept of safe and controlled management of hazardous wastes to protect human health and the environment. The hazardous waste management problem is extremely complex, and we recognize the Agency's difficulties in attempting to implement the hazardous waste provisions of RCRA with very short deadlines.

We are concerned, however, that the framework proposed in these regulations will be counterproductive to effective management of hazardous wastes. The proposed regulations are overly broad and based on a fundamentally unsound approach which will prove unworkable from economic, administrative and environmental viewpoints.

The proposal will have a severe impact on industry. Strict interpretation of the proposed rules as written will have a major negative impact on petroleum and chemical industries, particularly domestic oil production. The regulations will also spur inflation as they require extremely high compliance costs without benefits.

In some cases, the provisions of the proposal are beyond statutory authority and would place RCRA permit holders in additional jeopardy by incorporating regulations under other statutes into hazardous waste management standards.

The proposed regulations are not consistent with Executive Order 12044 which states that regulations shall be as clear and simple as possible, shall be cost effective, shall be developed in a manner that minimizes paperwork, and shall not impose unnecessary burdens. The proposed regulations require burdensome and costly compliance activities which will disrupt industry and delay energy development without producing a justifiable environmental or health benefit. The regulations are not clearly stated, and do require compliance activities which are not justified by the potential environmental or health problems involved. Because of the extremely costly and complex compliance problems, it is essential that the specific application of the regulations meet a genuine need in a cost effective manner.

The Agency has not justified the regulations with adequate supporting data and as a result, they have severely underestimated the impacts of the proposal. This has resulted in gross deficiencies in the Agency's Environmental Impact and Regulatory Analyses. We support the detailed comments on this aspect submitted by the American Petroleum Institute and the Manufacturing Chemists Association.

We anticipate that the unreasonable nature of these regulations, if promulgated, will cause extensive litigation and delay implementation. This delay is of considerable concern because we believe there are some serious hazards which should be controlled as soon as practicable. For this reason we urge the Agency to work with industry to identify priority wastes and to develop effective controls which could be implemented at an early date.

Detailed comments on specific sections of the proposed regulations are attached in a series of appendices:

Appendix A - Comments by Mobil Oil Corporation applicable to all operations.

Appendix B - Comments by the Exploration and Producing Division of Mobil Oil Corporation addressing oil drilling and producing operations.

Appendix C - Comments by the Exploration and Producing Division of Mobil Oil Corporation addressing surface coal mining and uranium mining and leaching operations.

In addition, comments on the proposed regulations have been submitted under separate covers by Mobil Chemical Company's Phosphorus Division and by the Electro-Phos Corporation, an owned subsidiary.

A summary of some of the more important issues addressed in the appendices is as follows:

1. The Agency has failed to differentiate the relative degrees of hazard posed by different types of wastes and has not assessed the potential risk to the environment in setting stringent performance standards. The overly broad definition of hazardous waste combined with the stringent requirements for management will be counterproductive and lead to the situation where compliance is impossible because of the shortfall of approved facilities. We endorse, in principle, the Manufacturing Chemists Association scheme for assessing a waste's degree of hazard and suggest that the Agency work with trade associations to develop regulations which incorporate a degree of hazard assessment. See appendix A, comment 4 for details.

2. The proposal indiscriminately applies stringent protection to all underground waters, regardless of their quality. The regulations should be revised to recognize the intent of Congress to protect drinking water and not those aquifers unsuitable for use as drinking waters. See appendix A, comment 17 for details.

3. The proposal exceeds statutory authority in seeking to incorporate standards under the Clean Water Act and Clean Air Act into hazardous waste standards and permits. This would place owners and operators of hazardous waste facilities in double jeopardy by making, for

• • •

4. Sec. 250.12 and 250.13, pg. 58950. These sections propose criteria and four hazardous waste characteristics (ignitable, corrosive, reactive and toxic). We are concerned with many aspects of these sections. The extremely broad criteria and characteristics will include many common materials and those of low hazard in the same group as those that are truly hazardous, subjecting them to the same regulations. Under these criteria and characteristics most discarded industrial materials will be hazardous. The criteria and characteristics are so broad that private and government office buildings would be classified as hazardous waste facilities because they generate, treat, store and disposed of paper. Paper is a hazardous waste as specified in the ignitable hazardous waste characteristic. Clearly, the intent of RCRA is to regulate hazardous wastes, not common materials such as this.

In setting the policies for hazardous waste management, the Agency has not addressed the degree of hazard associated with different wastes, or assessed the risk to the environment in setting a policy where almost all non-municipal waste materials will be hazardous wastes. This policy will overload facilities capable of handling truly hazardous wastes, and could result in a greater risk to the environment because disposal due to overloaded facilities.

Congress provided for an assessment of the degree of hazard in the definition of hazardous waste - RCRA Sec. 1004(5). A hazardous waste is... "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may - "(A) cause, or significantly contribute to an increase in mortality or an increase in serous irreversible, or incapacitating reversible, illness; or "(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." In recognizing the effects of quantity, concentration and characteristics, RCRA provides for an assessment of the degree of hazard of a waste.

We recognize the difficulties in developing a definitive classification scheme to accurately assess a waste's degree of hazard. One approach to making this assessment has been developed by the Manufacturing Chemists Association (MCA). Mobil endorses MCA's approach in principle as a reasonable scheme to provide the flexibility needed for workable regulations. The MCA approach, shown below, proposes criteria for three different hazardous waste classes.

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PAGE 58947 - Court orders and March 16th comment closing.

The Agency's difficulties in meeting court mandated promulgation dates are appreciated, however, no proposed regulation should be promulgated without an adequate background in fact. A regulation characterized in the introduction as extraordinarily complex, difficult, and comprehensive, requires an adequate and complete environmental impact statement which does not in our judgment exist for the regulation as a whole and certainly not as related to major impacts on oil drilling and production operations. The environmental impact statement should be expanded to more completely evaluate impacts of selected and alternate regulatory choices.

APPENDIX B
page 6

PAGE 58948 - State Responsibilities

The impact analysis appears to inadequately assess state resources and the ability of the states to implement the regulation and assure costly continued compliance. In the case of oil drilling and production comprehensive regulations using alternate proven approaches are already in place.

0.6 American Petroleum Institute

COMMENTS ON PROPOSED
HAZARDOUS WASTE GUIDELINES AND REGULATIONS OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
PURSUANT TO
SECTION 3001, SECTION 3002, AND SECTION 3004
OF THE
RESOURCE CONSERVATION AND RECOVERY ACT

Submitted By The
AMERICAN PETROLEUM INSTITUTE

March 16, 1979

American Petroleum Institute
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[illegible] D.C. 20037
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Daniel B. Rathbun
Vice President

[illegible]
3/16/79

March 16, 1979

John P. Lehman
Director, Hazardous Waste Management
  Division
Office of Solid Waste (WH-565)
U. S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Lehman:

The American Petroleum Institute (API) hereby submits the following comments on the proposed hazardous waste guidelines and regulations of the Environmental Protection Agency (EPA) prepared pursuant to Subtitle C of the Resource Conservation and Recovery Act (RCRA). 43 Fed. Reg. 58946 (Dec. 18, 1978). API appreciates the opportunity to respond in detail to a comprehensive program which addresses a health and environmental issue of major significance. The recommendations presented in the API comments represent another step in the continuing dialogue between EPA and the public that has existed since the enactment of RCRA and EPA's initial efforts to implement the statute. API requests that the comments it has submitted regarding earlier drafts of the proposed regulations be reviewed again prior to the final promulgation of any rules.

As specifically mentioned in the testimony presented in Denver, Colorado on March 7-9, 1979 and in the March 11, 1979 letter to Mr. Steffen Plehn, Deputy Assistant Administrator for Solid Waste, API has two on-going projects germane to issues in the proposed regulations. API plans to submit the final results of these projects within 60 days for consideration by EPA.

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In preparing these comments, API has sought to provide constructive suggestions which will assist EPA in implementing the letter and spirit of Subtitle C of RCRA, in effecting a regulatory program for the effective management of hazardous waste. To this end, API remains ready to provide additional assistance.

Should you have any question regarding the API comments, please feel free to contact Mr. Eldon Rucker (202/457-7087), Dr. Steven Swanson (202/457-7363), or Mr. Stephen Williams (202/457-7384).

Sincerely,

Daniel B. Rathbun

American Petroleum Institute
[illegible] L Street, Northwest
Washington, D.C. 20037
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Daniel B. Rathbun
Vice President

March 12, 1979

HAND DELIVERED

Mr. Steffen Plehn
Deputy Assistant Administrator
for Solid Waste
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Environmental Protection Agency
401 M Street S.W.
Washington, D.C. 20460

Dear Mr. Plehn:

As you may know the American Petroleum Institute (API) recently appeared at the EPA hearings (March 7-9) on the Resource Conservation and Recovery Act in Denver, Colorado, to present formal testimony on Sections 3001, 3002 and 3004 of the proposed regulations, published in the Federal Register on December 18, 1978.

During API's oral presentations on Section 3001 and 3004, we indicated that, while API will submit as much technical data as possible by the March 16 deadline, we expect to receive final reports from our contractors (concerning economic impacts and a proposed alternative for Section 3001) during the latter half of March. We would like to submit this additional data as soon as we receive it to be included in the public record and considered by the Agency. This letter is to request your formal approval for this extension.

We would greatly appreciate your granting permission for this extension and look forward to hearing from you at the earliest possible date.

Thank you for your prompt consideration in this important matter.

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allowance is made for variations in individual plants, as EPA has done by including a variance clause in its 1977 limitations." E. I. duPont de Nemours & Co. v. Train, 430 U.S. 112, 128 (1977).

The note system proposed by EPA fails to meet these requirements, as explained in more detail in Part III of our comments, by failing to allow variances in many situations.

b. The Proposed Regulations Are Invalid Due to Vagueness

As described in detail in Part III of the API comments, many portions of the regulations fail to define or provide an adequate explanation of the manner of implementation. This lack of precision offends the well-established principle that a law "is void for vagueness if its prohibitions are not clearly defined. Grayned v. Rockford, 408 U.S. 104-108 (1972); Ashton v. Kentucky, 384 U.S. 195, 200 (1966).

5. The Draft Environmental Impact Statement Fails to Satisfy the Mandate of NEPA and Underscores EPA's Failure to Comply With RCRA

a. The DEIS Documents EPA's Imposition of Requirements Which Unnecessarily Cause Irreparable Harm In Contravention of NEPA's Mandate to Minimize Adverse Environmental Effects Which Cannot Be Avoided

Section 102(2)(C) of NEPA requires EPA to prepare a "detailed statement" analyzing:

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

One of the major purposes of these requirements, as made clear in Section 101 of NEPA is to "attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences" and "maintain wherever possible, an environment which supports diversity and variety of individual choice." (NEPA, Sections 101(b)(3) and (4), respectively).

The DEIS, although deficient as to some of the Section 102(2)(c) requirements, demonstrates that EPA's proposal will violate Sections 101(b)(3) and (4) by imposing requirements which will cause more harm than good. For example, the DEIS predicts that there may be substantial shifts from on-site to off-site disposal. (See, e.g., DEIS at p. 7-33, 7-34). Such shifts will result in greater hauling distances (See, e.g., p. 7-20) causing increased air pollution and congestion in many areas. (See, e.g., DEIS at p. S-26 and p. 7-71 et. seq.).

The DEIS points to another impact of the proposed regulations which is contrary to NEPA's purposes of maintaining land for a variety of uses; that is, "[m]ore total land, off-site, plus on-site, would be required for hazardous waste management under the Subtitle C regulations than for hazardous waste management under current practices." (DEIS at p. 7-200).

The DEIS explains that "[e]xisting land uses would cease, either permanently or temporarily, on all land converted to hazardous waste management uses. Some agricultural, grazing, forest, recreational, and other lands could be removed from their existing uses." (DEIS at p. 7-201).

b. The DEIS Fails To Assess Whether Benefits Justify Costs

EPA's Draft Environmental Impact Statement makes no attempt to balance costs and benefits and thus clearly fails to comply with the requirement set forth in Calvert Cliffs' Coordinating Committee, Inc. v. U.S. Atomic Energy Commission, 449 F.2d 1109, (D. C. Cir. 1971), cert. denied 404 U.S. 942 (1972).

Specifically, the Court said:

> NEPA mandates a case-by-case balancing judgment on the part of federal agencies. In each individual case, the particular economic and technical benefits of planned action must be assessed and than weighed against the environmental costs; alternatives must be considered which would affect the balance of values. ... The magnitude of possible benefits and possible costs may lie anywhere on a broad spectrum. Much will depend on the particular magnitudes involved in particular cases. In some cases, the benefits will be great enough to justify a certain quantum of environmental costs; in other cases, they will not be so great and the proposed action may have to be abandoned or significantly altered so as to bring the benefits and costs into a proper balance. The point of the initial balancing analysis is to insure that, with possible alterations, the optimally beneficial action is finally taken.

449 F.2d at 1123.

As an instrument to be used in the decision-making process, the failure of the DEIS to address costs and benefits indicates that EPA did not balance the "pros and cons" of the proposed program in order to minimize environmental and economic disruptions. Further, the failure to estimate costs and benefits makes the consideration of alternatives to the proposed action impossible. The DEIS is particularly deficient in its discussion of the alternatives it considered to the proposed program.

This glaring omission to balance costs with benefits is not corrected by the Draft Economic Impact Analysis (DEcoIA). As explained in detail in Part III of the API comments, the DEcoIA omits costs incurred by several important segments of the petroleum industry. For example, the proposed Section 3004 regulations contain specific requirements for waste streams from the exploration and production segment of the petroleum industry. Nowhere in the EPA Environmental or Economic Impact Analyses is economic impact for these facilities analyzed.

Further, in estimating the costs to the refining segment, EPA has excluded from its DEcoIA an assessment of the enormous cost of upgrading NPDES permitted surface impoundments. These are just a few of the omissions from EPA's analysis, but these alone demonstrate the failure to comply with the statutory requirements.

0.7 Dow Chemical U.S.A

DOW CHEMICAL U.S.A.

BENNETT BUILDING
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MIDLAND, MICHIGAN 48640

March 6, 1979

Mr. Douglas M. Costle, Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

PETITION

RE: COMMENT PERIOD ON EPA'S PROPOSED RCRA §§3001, 3002, AND 3004 (43 FEDERAL REGISTER 58946, DECEMBER 18, 1978)

Dear Mr. Costle:

The Dow Chemical Company respectfully petitions that the due date for public comment on EPA's proposed regulations implementing Sections 3001, 3002, and 3004 of the Resource Conservation and Recovery Act of 1976 proposed in the December 18, 1978 Federal Register (43 Fed. Reg. 58946 et seq.), and now set to expire on March 16, 1979, be extended. We request that the comment period remain open until at least 60 days after the proposal of all regulations implementing Subtitle C (Sections 3001-3011).

The requested extension of the comment period is proper for the following reasons:

(1) Although the regulations for Sections 3001, 3002, and 3004 were proposed on December 18, 1978, the 4,294 pages of background documents were not available for review until January 8, 1979, and published copies of the draft Environmental Impact Statement (EIS) were not available for distribution until early February. The integrated permit regulations pursuant to Section 3005 of the RCRA and the National Pollutant Discharge Elimination Systems (NPDES) and Underground Injection Control (UIC) programs, have not yet been proposed. Regulations for Sections 3003, 3006, 3010, and 4004 were previously proposed in mid-1978 before the characteristics of hazardous waste described in proposed Section 3001 were fully developed. This piece-meal proposal and promulgation has made coherent overall assessment of the changes occurring among the individual Sections of the regulations impossible.

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

(2) The regulations proposed to implement Section 3004 are incomplete to the extent that they employ "notes" or reference "permits issued pursuant to Subpart E". The regulations setting out the scope and coverage of the permit under Subpart E have not yet been proposed. The use of "notes" according to the Agency "will be explained in more detail in EPA's proposed Subpart E rules" (43 Fed. Reg. 58983, column 2). These gaps in the proposed regulations make it impossible to provide informed and meaningful comments to the proposed rules as assured by both the Administrative Procedure Act, 5 U.S.C. §553, and Executive Order 12044 (43 Fed. Reg. 12661).

Sincerely,

James M Kuszaj

James M. Kuszaj, Attorney
U.S.A. Legal Department
2030 Dow Center
(517) 636-1215

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DOW DOW CHEMICAL U.S.A.

BENNETT BUILDING
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MIDLAND, MICHIGAN 48640

March 15, 1979

COMMENTS OF
THE DOW CHEMICAL COMPANY
ON RCRA SECTIONS 3001, 3002, & 3004
43 FEDERAL REGISTER 58946 ET SEQ
DECEMBER 18, 1978

Mr. John P. Lehman
Director, Hazardous Waste Management Division
Office of Solid Waste (WH-565)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Lehman:

Enclosed are detailed comments of Dow Chemical U.S.A. on the Agency's proposed regulations implementing Sections 3001, 3002, & 3004 of the Resource Conservation and Recovery Act of 1976, proposed in the December 18, 1978, Federal Register (43 Fed. Reg. 58946 et seq.). In addition, our comments on the Advance Notice of Proposed Rulemaking which appeared in the December 18, 1978, Federal Register at page 59022-59028 are included as part of our discussion of the proposed Section 3001 regulations.

As you are aware, Dow Chemical U.S.A. has actively participated in the regulatory development process, and has worked closely with the Agency, and with various trade associations, professional societies, and standard setting groups to develop a consistent set of meaningful regulations for hazardous waste management. However, many of the regulations now being proposed are unrealistic and are unnecessary to reasonably protect human health and the environment.

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

DOW CHEMICAL U.S.A.

JOHN BEALE
MANAGER, ENVIRONMENTAL REGULATORY
ACTIVITIES FOR SOLID WASTE

Environmental Quality
2030 Dow Center
Midland, Michigan 48640

517-636-2067

The enclosed comments are divided into two parts. The first part sets forth a general summary of our major concerns. The second part contains a detailed section-by-section analyses of the proposed regulations, with recommendations for modification where appropriate. We urge the Agency to give careful attention to the revision of the proposed regulations.

Should the Agency wish to discuss any of the issues raised in our comments in greater detail, please contact John S. Beale.

Sincerely,

John S Beale

John S. Beale
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APPENDIX P

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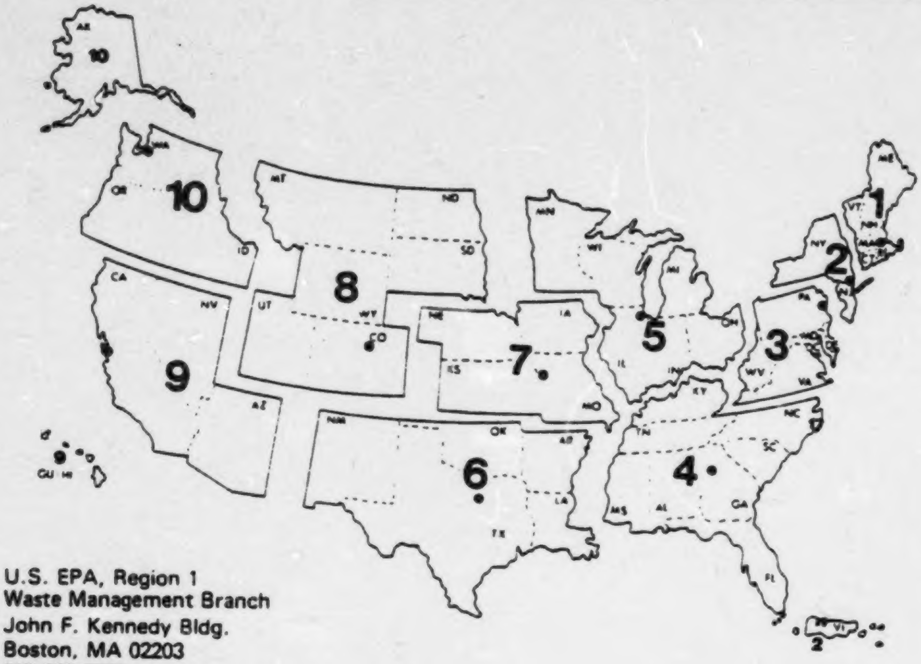
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Hazardous Materials Branch
6th and Walnut Sts.
Philadelphia, PA 19106
215-597-7370

U.S. EPA, Region 4
Residuals Management Br.
345 Courtland St., N.E.
Altanta, GA 30365
404-881-3016

U.S. EPA, Region 5
Waste Management Branch
230 South Dearborn St.
Chicago, IL 60604
312-353-2197

U.S. EPA, Region 6
Solid Waste Branch
1201 Elm St.
Dallas, TX 75270
214-767-2645

U.S. EPA, Region 7
Hazardous Materials Branch
324 East 11th St.
Kansas City, MO 64108
816-374-3307

U.S. EPA, Region 8
Waste Management Branch
1860 Lincoln St.
Denver, CO 80295
303-837-2221

U.S. EPA, Region 9
Hazardous Materials Branch
215 Fremont St.
San Francisco, CA 94105
415-556-4606

U.S. EPA, Region 10
Waste Management Branch
1200 6th Ave.
Seattle, WA 98101
206-442-1260

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